A NEUROPHYSIOLOGICAL THEORY OF ANIMAL ETHICS

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Part I: Singer's Ethics & its Problems

In *Animal Liberation*, Peter Singer argues that we are morally obligated to give non-human animals (from now on, simply "animals") a certain degree of moral consideration. Specifically, Singer argues that we must take into account the interests of all sentient beings in order to determine our ethical actions with respect to treatment of these beings. Historically, humans have tended to take into account only human interests and have used animals for whatever "trivial" purpose they deemed necessary (food, test subjects, etc.). Singer argues directly against this historical use of animals and claims that once one gives even basic moral consideration to sentient animals – as one should – it becomes apparent that, in at least the majority of cases, the eating of meat and the use of animals as test subjects for medical experimentation is immoral. For Singer, the only morally relevant criterion for determining whether a living being deserves moral consideration (which lays the foundation for how we should treat it) is sentience, which is roughly having the capacity to experience pain or pleasure. He argues that all sentient beings deserve the same moral consideration though not necessarily the same treatment. Rather, different creatures deserve different treatments based on differences in their interests. Fundamentally, all sentient creatures have an interest in avoiding pain and experiencing pleasure, but there are many unique interests creatures have that depend on their specific nature. For example, cows might have an interest in living as part of a group (because they are a herding species) while other species – such as bears – have no such interest, as they are a solitary species. However, the interests of all sentient beings should be considered without any species bias (particularly without giving human interests a greater weight than non-human

interests). Thus, Singer claims his theory isn't a *description* of how to treat sentient creatures, but rather a *prescription* (Singer, 1995, p. 2).

However, because Singer's theory only offers us the prescription that we should give all sentient animals equal moral *consideration* but does not specify how we should in fact *treat* different animals and humans, it ends up being too general given the complexities of human life. That is, Singer's theory amounts to absolute prohibitions of most of the historical uses humans have made of animals, such that there is no room for more fine-grained distinctions at the level of very basic, practical cases that many people are confronted with on a daily basis. Certainly, in obvious cases such as factory farming, Singer tells us that the human interest in eating meat is much less significant than the animal's interest in not being subjected to factory farming (in fact, Singer might disqualify the human interest as being a valid interest at all: perhaps it's just a trivial desire) and thereby provides a clear guidance for our actions (i.e. 'don't consume factory-farmed meat'). The justification for this particular conclusion is that humans – at least according to Singer – derive comparatively little pleasure from eating meat, while animals suffer extensively during factory farming. However, in less obvious and more complex cases, such as when weighing our interest in eating meat against the interests of an animal that is raised humanly and slaughtered nearly painlessly, Singer's theory offers little beyond a general prohibition on the usage of animals. Fundamentally, Singer has little to say about which interests matter more in such cases and what difference this should make for our actions, because he only stresses the importance of treating animals with equal consideration. While we are trying to consider animals equally, we stumble upon different *kinds* of interests and sometimes it is difficult to tell exactly what interests an animal has and how those interests should compare to human interests. Then, there is a further question of how our considerations should be reflected

in our actions. Therefore, without further qualification, Singer's theory is not precise enough to translate equal moral consideration into different kinds of actions that could be useful in daily life.

To be fair, Singer does attempt to qualify his theory on occasion and ascribes different kinds of capacities and interests to different kinds of animals throughout *Animal Liberation.* For example, Singer claims that all sentient animals can experience fear and stress as well as pain, and implies that they have a corresponding interest to avoid these things (1995, p. 13). He goes on to say that the line of sentience is to be drawn somewhere around mollusks (1995, p. 174). This means that all creatures "below" mollusks are not sentient while all creatures "above" mollusks, are. *However*, most of these ascriptions are based on now outdated science and – what is methodologically speaking even more problematic – on behavioral evidence which is a notoriously poor indicator of mental states. Generally, behavioral observation suggests that animals have more cognitive capacities than they in fact possess because humans have a tendency to anthropomorphize and to see intentionality even where there isn't. For instance, Singer suggests that a wide scope of animals have a relatively complex set of capacities which correspond to the capacities humans displaying the same behavior possess. Thus, when we see a dog hide under the bed after eating his owner's shoes, we would – under this model – assume that the dog feels ashamed, since if a human had destroyed someone's possessions, he might have behaved similarly out of shame when facing the owner of those possessions.

Furthermore, when behavioral evidence is inconclusive about whether or not a creature is sentient, Singer argues we should treat it as if it were sentient (1995, p. 174). This means that, under his theory, creatures that *may* be sentient receive equal moral consideration as creatures that are *obviously* sentient. And very often this equal consideration includes the consideration of

anthropomorphized interests that the creature may or may not actually possess. The result of this "hyperextension" of the scope of moral consideration is that creatures that actually *do* have particular interests run the risk of receiving less moral treatment than they should because creatures that merely *appear* to have particular interests receive too much moral treatment. This phenomenon will be discussed more in the next section.

The argument presented in the rest of this paper has two main goals. In *Part I*, I will argue that Singer's theory is not capable of providing precise enough guidance with regard to what ethical choices we should make in the less obvious and more complex cases. This is, first, because Singer's theory doesn't distinguish between different kinds of interests and their relative moral weight and does not specify which creatures have which interests. And, second, even if we try to make Singer's theory more precise, under his framework, moral consideration is skewed in favor of creatures with lesser mental capacities because of his low threshold of sentience as the criterion for moral consideration. This can be problematic because a focus on sentience alone can lead to creatures with greater mental capacities receiving the same or even a lesser treatment than the creatures with lesser mental capacities (that result in a diminished ability to hold a particular interest). From the perspective of common sense, the creatures with greater mental capacities thus end up being treated 'unfairly'.

Next, in *Part II*, I will propose an alternative to Singer's view that uses neurophysiology as the foundation for establishing a clearer differentiation between creatures' mental capacities, and then uses these new distinctions as a basis for determining how different creatures ought to be treated. My alternative neurophysiological theory of animal ethics offers more precise prescriptions for which capacities matter most for ethical consideration and identifies which particular animals possess these capacities. In doing so, my theory possesses a level of precision

that a theory of ethics needs in order to be useful in practical cases. However, this precision comes at a cost: the neurophysiological theory is based on cutting-edge science which is controversial in many places and downright contradictory in others. Because the science is not firmly established, I take the presentation of the neurophysiological account to be an approximation that is open to change in light of further developments in neuroscientific research. However, I still think it is very important to offer something constructive to the discussion of animal ethics rather than mere criticism of other views. With that said, I will present the scientific evidence that I take to be the most plausible given our current state of affairs, with the caveat that, at any time in the future, this evidence could be modified or even refuted. My ultimate goal, then, is not to provide a definitive account of animal capacities as they relate to ethics, but rather a view that can function as a model for a principled method for determining the kinds of capacities and interests that should be considered important for animal ethics.

I.1 Singer's Ethical Framework

Allow me to start by outlining the logical steps that lead to Singer's proposal. This will help to show the basic foundation of his version of utilitarianism, which, in turn, forms the foundation of both Singer's and my own proposal for an animal ethics. In *Practical Ethics*, Singer lays the groundwork for his version of preference utilitarianism. He argues that for an act to be ethical it must be justified in a certain way. Most notably, self-interest cannot be the justification for any act that is supposed to be ethical because ethics takes a universal point of view. Ethics must take a universal point of view because there are other beings (other humans, at least) that have the same interests I do (Singer, 1993, p. 11). If I recognize my own interests as

valuable, then, when another being has the same interest, I must recognize that interest to be valuable as well. In this sense, it is the interest that carries the value, not the being that possesses the interest. Therefore, when multiple beings have the same interest, each of their interests is worth the same amount (ethically speaking), regardless of which being the interest is found in. So, not only are the interests of others valuable, insofar as their interests are the *same* as mine, they are *just* as valuable as mine. As Singer concludes, my interests, just because they are mine, cannot count for more than the interests of similar beings (1993, p. 12).

Once we realize that the interests of other people have moral weight in a similar way to our own, we must take into account the interests of everyone affected by an act to determine whether or not it is ethical. The best course of action, then, is the one that has the best consequences for all of those affected (Singer, 1993, p. 13).[1] Here, "the best consequences" are those consequences that maximize satisfaction of interests for those involved, while spreading the benefits over as many of those involved as possible. Imagine there are three people that all have an interest in eating a single slice of cake. If one of them eats the entire slice of cake, her interest will receive maximum satisfaction but the other two people's interest will be completely frustrated. Similarly, if two people share the slice their interest will be satisfied – though to a lesser degree than it would have been if either one of them would have eaten the whole slice – but the third person's interest remains frustrated. Therefore, due to diminishing returns, it might be preferable for all three people to share the slice so that each of them have their interest satisfied to some degree. This example is supposed to illustrate that both the degree to which interests are satisfied and the degree to which satisfied interests are spread over all those

[1] Here, it is not entirely clear if Singer has in mind a maximizing utilitarianism (where total interests are maximized) or a balanced utilitarianism (where interests are maximized while spreading the benefits over all those who are involved). It seems like Singer usually endorses a balanced utilitarianism, but he is not very strict with his terminology.

involved are important for the moral justification of actions. There will be, of course, a balance between maximally satisfying interests and spreading the satisfaction as widely as possible. It is difficult to specify what this balance exactly entails on an abstract level, but it will become clearer later when I discuss some practical cases.

So far, I (on Singer's account) have argued that the universality of ethics requires that we give value to the interests of others and that we must take those interests into account when making ethical decisions. Therefore, we have arrived at the kind of preference utilitarianism which Singer believes is the first logical step after accepting the universality of ethics. To progress beyond preference utilitarianism, we would have to adopt further moral rules (such as that we should only care about pleasure and pain for classical utilitarianism, or that we should treat everyone as an end rather than a means for a traditional Kantian perspective). However, Singer thinks we should have good reasons before we adopt any additional moral principles and "until such reasons are produced, we have some grounds for remaining utilitarians" (1993, p. 14). Singer clearly thinks that preference utilitarianism is sufficient for making informed ethical decisions, but he seems willing to discuss other ethical theories as well in *Practical Ethics*. In this, Singer seems to advocate the view that there may be multiple ethical systems capable of informing our ethical decisions but that preference utilitarianism has the power of some of the "higher" systems without the inclusion of additional premises.

One of the attractive features of preference utilitarianism is that it does not directly deal with people, but only with people's interests, which makes it the case that features like social class, skin color, and creed are completely irrelevant to morality. In addition, everyone's experiences count for the same amount; recall Bentham's statement that remains at the pinnacle of utilitarianism, "Each to count for one and none for more than one." When the only subject

matter for moral consideration is the human species, it can be assumed that human preferences are directly comparable because most humans have roughly the same mental capacities. Mental capacities are important because if humans had especially different mental capacities, you might imagine that if two people had the "same interest" (for example, eating a slice of cake) that one might be physically capable of expressing the interest to a greater degree. For example, a person that has the ability to taste the cake might have a much greater interest in the cake than someone who cannot taste it (because her brain does not process taste sensory data) and wants it for nutrients alone. Because of similar brain function among humans, there is little problem homogenizing interests among people and claiming that the same interest present in two people might have the same value. In fact, the homogenization is probably beneficial because it gets rid of other factors that have little to do with morality like those mentioned above. Some may doubt whether such homogenization of interests, even among humans, is in fact possible, but for the purposes of this paper, I assume that interests (as a function of mental capacities) among people are similar *enough* to warrant this homogenization.[2]

In *Animal Liberation*, Singer extends the utilitarian framework (complete with homogenization) to all sentient creatures, a move that, in principle, causes no problems. It seems possible, at least in principle, that sentient creatures might have similar mental capacities (at least as is relevant to some interests) as the result of biological conservation in evolutionary history. Admittedly, heterospecific (from different species) capacities would be more dissimilar than conspecific (from the same species) capacities but heterospecific capacities might still be similar enough to fit together into the same moral theory. Singer acknowledges this problem but

[2] Here, I am deliberately omitting discussing people with intellectual and some relevant bodily disabilities. Their interests are obviously different than "normal" human interests but this difference isn't especially important for the discussion at hand.

generally compares interests on different orders of magnitude so that the question of how similar human interests are to animal interests rarely comes up. For example, Singer often compares a human's interest in eating meat to an animal's interest in avoiding the process of being raised and slaughtered for food. For the purpose of logical consistency, at least, there is no obvious problem with comparing human and nonhuman interests.

That is not to say that humans and nonhumans have the *same* interests. There are two senses in which beings can have the same interests. As Singer discusses, different sentient beings have different interests. A pig has no interest in voting while a human does. Similarly, most humans have no desire to wallow in mud or graze in a pasture like a pig or a cow might. Despite this, some interests seem to be roughly preserved among creatures: not being confined to small spaces, not being physically injured, having adequate food, drink, and shelter; and so on. This is one respect with which human and nonhuman interests can be the same. For example, both humans and pigs have an interest in quenching their thirst.

However, there is another sense in which interests, being mental entities, are based on mental capacities. Singer doesn't discuss this second sense of sameness much in *Animal Liberation.* In this second sense, it seems that even if both pigs and humans have an interest in quenching their thirst, one may possess the interest *to a greater degree* than the other. However, even with degrees of interest aside, the fact that many interests vary among creatures leads Singer to describe his theory as a prescription of ethical *consideration* rather than a description of ethical *treatment*. Singer *prescribes* that we treat all sentient beings with equal consideration as traditional utilitarianism requires (1995, p. 2). For Singer, this means we must give equal consideration to the interests of all sentient beings (specifically, regardless of species

membership). However, beyond giving equal consideration, Singer's theory does not describe how we should actually *treat* sentient beings.

This becomes a problem because interests are often in conflict with one another. For instance, many humans have an interest in consuming cheap (factory-farmed) bacon while a pig may have an opposing interest to be treated well and to continue to live. When interests are in conflict, keeping true to utilitarianism, a form of "utilitarian calculus" is required in which the conflicting interests are weighed against one another. In the case of bacon vs. pig, it seems clear that the pig's interest in avoiding factory farming is much greater than a human's interest in eating cheap bacon so it is immoral to subject the pig to a factory farm for the purpose of producing bacon with minimized monetary cost. This is an easy case and Singer handles this one (and many similar ones) in *Animal Liberation*. Given the atrocities that occur within factory farming (which I feel no need to go into here)[3], it would take an enormous interest conflicting with the interest of avoiding being factory farmed to come up with a circumstance in which factory farming would be acceptable.

Despite being able to handle easy cases, Singer's theory has much less to say about more complex ones. For example, should we eat animals raised humanely and slaughtered painlessly (or almost painlessly)? Are pescatarians (people who abstain from all meat except fish) being more moral than the average meat eater or is it as wrong to eat fish as other animals? What about eating chicken rather than beef? Questions such as these are ones that Singer has trouble answering because his theory isn't descriptive enough about how we should handle certain kinds of interests and it does not provide a proper background for establishing which animals are

[3] If you would like to read more about factory farming, I recommend *Animal Liberation*. Singer does an excellent job of describing many practices of the industry, though the book may be a bit outdated. The PETA website provides a more current, through extreme, picture of factory farming.

sentient and which interests those animals have. To reply to all of these questions, Singer would argue that *whenever* we are in doubt we should just abstain from eating any animal. However, such a reply fails to take into account the real complexity of issues that are a matter of degree rather than simply a binary answer of right or wrong. First, I will discuss how Singer's theory isn't descriptive enough when it comes to interests. Then, I will go on to discuss issues with ascribing interests to nonhuman creatures using anthropomorphic behavioral observations.

I.2 The First Problem – Undefined Interests

When Singer develops his "equal consideration for all" framework, he doesn't speak explicitly about interests. This leads to two related problems: how should we treat different creatures with the same interest and which interests are the important ones? To reiterate a portion of the discussion above, there are two ways in which an interest can be the same. It can be the "same" interest (where the same means the same in kind, e.g. in avoiding pain) or same might mean to an equal degree in accordance with mental capacities. To attempt to avoid confusion between the two, I will refer to the first sense of sameness as having the *same interest* and the second sense as having an *equal interest*. Singer argues that when creatures have the same interests, the way we give those creatures the equal consideration is to *treat* the creatures the same. However, it seems that we have an intuition that if you were to subject different animals to the same treatment, it would be worse for some than for others. This could be because, as Singer states, animals have different *additional* interests, but it could also be because some animals hold the same interest *to a greater degree* than others. In other words, though two creatures might have the *same* interest, they may not have *equal* interest.

For example, it seems intuitive that cows feel more pain than fish. This intuition is displayed in our everyday culture; no one (to my knowledge) has ever taken off work to place some bait on a large metal hook and thrown it into a cow pasture hoping to "get a bite." In fact, that seems very cruel though many people wouldn't think twice about going on a fishing trip. Indeed, this may just be a cultural notion and we may have just as easily developed into a culture of cow-fishers but it seems (to this author, at least) that the inclination against cow-fishing runs deeper than a mere cultural preference.[4] Thus, we have two different creatures that both have the same interest (not experiencing pain from the hook) but our intuitions suggest that a cow might hold that interest to a greater degree than a fish. In fact, this is not just our intuitions but is also suggested by neurophysiology, as I will discuss later. Alternatively, you might say that the cow and the fish` only *seemed* to have the same interest but, when viewed at the species-level, actually do not. This is another formulation of the same idea, both of which encompass the fact that mental capacity (as can be approximated by species membership) is important for determining the value of interests.

If we apply Singer's theory to cow-fishing we know that we must give both cows and fish equal consideration. When we do, we arrive at the fact that both animals have an interest in not experiencing the pain from being hooked. However, it isn't clear that either animal holds that interest to a greater degree[5]. Even the discussion of a cow having a greater interest in avoiding

[4] Even if this is not an intuition shared by others, the strength of my argument does not rely on this intuition. Positing it here is merely an introduction to the problem of cow-fishing that I will discuss in more detail later, after I have advanced my neurophysiological theory.

[5] Singer might argue that in the mode of giving equal consideration, equal consideration includes taking into account the degree to which a creature holds the interest before deciding how to treat a creature. However, this way of doing things is blunt and leaves things less clear in the theoretical “consideration” stage than is to be desired from a practical theory. It would be better to give different consideration to a creature depending on the degree to which it can hold interests in order to have a clearer picture at the theoretical stage.

pain seems to border on speciesist talk. This is because, without substantial qualification of *why* a cow might have the greater interest (in terms of something other than being evolutionarily closer to the human species), it *is* speciesist. However, Singer's theory doesn't inherently have the power required to explain why a creature might hold the same interest to a greater degree than another. This is a result of Singer using primarily behavioral evidence, which is methodologically risky, as I will discuss in the next section. Thus, it appears that Singer's theory would claim that it is equally wrong to fish and to cow-fish to avoid speciesism. However, by treating cows and fish equally, Singer actually ends up giving the cow relatively less consideration than it deserves (deserves, here meaning: should be given based on biological capacities for suffering) because he gives the fish relatively more. Later, I will discuss how our intuitions are actually correct in this case and explain in more detail the damage that is done when relative considerations are skewed.

As mentioned above, when Singer doesn't make explicit the relative values of interests, it is not clear which interests are the important ones and which interests are more trivial. This makes determining what is moral in practical cases difficult, especially when the interests are somewhere close in magnitude. Singer can easily say we shouldn't eat meat from factory farms because our interest in eating meat is much less significant (less intense and less important, as far as interests go) than a pig's interest in living a pain-free life. However, if we imagine that the case changes and that the pig has been raised on a very humane farm and killed as closely to painlessly as possible, the argument for abstaining from eating the pig becomes much weaker. Singer clearly thinks that eating humanely raised animals is still wrong but he doesn't give a strong argument for it in *Animal Liberation.* In fact, he offers an argument that killing animals, even painlessly, is disrespectful and leads us to treat animals as objects. Once we see them as

objects, we will have no qualms with causing them harm (1995, p. 229). Thus, he offers an argument based on human nature that we shouldn't kill animals. This argument could likely be disputed by simply denying that it is human nature to regard animals as objects after killing them for it seems that wanting to painlessly kill animals is indicative of treating them as more than objects. Even if not, it certainly doesn't seem to follow that by wanting to limit the amount of harm we cause animals when we kill them, we will end up not minding when we cause them harm (it seems closer to contradictory). Singer admits this argument isn't a strong one but is there any more to be said?

If we try to answer the case ourselves using Singer's theory, we run into problems. Much like in the case of factory farming, the pig still has an interest in not feeling the pains of being raised and slaughtered and the human still has an interest in eating meat, however, now it is not clear that the pig's interest is more significant than the human's. For now, let's omit the discussion of death as a harm because that is more complicated than it may appear and I will discuss it later. As we have already stipulated in the case, the pig will only experience a very marginal amount of pain during slaughter. This small amount of pain doesn't seem to clearly trump the pains (in the forms of inconvenience, social rejection, and dietary limitation in a culture that eats predominantly meat) experienced by a human when avoiding eating meat as many meat-lovers turned vegetarians may tell you. At least in the United States, meat-eating is engrained in the culture such that it is no small matter to give it up. Many holidays revolve around meat (Thanksgiving turkey, Christmas ham, Fourth of July cook-out) as do many pastimes (game-day tailgating, fish-frys, oyster roasts, bar-b-ques). In fact, many consider one of the finest meals to be steak (filet mignon to be specific) and, as such, there are many steakhouses all around the country. My point is that meat-eating is incorporated into American culture such

that it is not simply a preference that many Americans could easily give up. Therefore, I take it that Americans (and probably humans in general though Americans certainly seem to eat the most meat) have a pretty serious interest in eating meat.

Additionally, while it is clearly possible to obtain sufficient nutrition from a plant-only diet, it is significantly more difficult than doing so on a diet that includes meat or animal-based products. Also, vegetables (especially fresh vegetables) are generally more expensive than meat in the United States. This serves to further limit the number of people that can feasibly relinquish meat and increase the burden of doing so on those who can. These inconveniences for a human are more than likely not as serious as an animal's interest in avoiding factory farming but quite possibly more serious than a pig's interest in not being humanely raised for meat. Singer's theory doesn't tell us which interest is more important but if we pick based on the interest of avoiding pain, it may well be the pig ends up experiencing less pain. However, Singer still implies that eating the humanely raised pig would be wrong.

Perhaps this is because pigs have an interest in continued life. If pigs have this interest then surely it would prove to be more significant than a desire to eat meat. After all, it seems to be some kind of interest in continued life (ignoring the cultural revulsion of eating human meat) that causes it to be immoral to eat another human should we find one with no ties to anyone else and painlessly euthanize him. We know humans have an interest in continued life but do pigs? Well, in some sense they do for certain. Much in the way a plant might have an interest in being in sunlight, a pig might have an interest in continuing to live. However, it's not that the plant is *interested* in sunlight but really just that sunlight might be beneficial to the plant. This kind of interest does not fit well into the subjective ethical system (utilitarianism) that Singer's proposal

stems from**.** This is because ethically relevant interests are mental entities. That is, a being has interests in virtue of having a particular mental capacity. For example, a being has an interest in avoiding pain in virtue of having the capacity to feel it. A plant has no mental capacity that would be sufficient for having an interest in being in sunlight (because plants have no mental capacities at all).

For the pig to have an interest in continued life, it must have some sort of specific mental capacity (because all interests are mental entities). Simply existing is not sufficient for having an interest to continue to do so. I won't discuss here what mental capacity is sufficient for having an interest in continued life because Singer's theory doesn't have the means to do so. We think intuitively that pigs might have whatever a sufficient capacity might be, but it may be that this is just anthropomorphism. Therefore, it isn't clear that pigs possess an interest in continued life and Singer's theory does no more to elucidate whether they do or do not. However, without an interest such as continued life, based on Singer's view, it seems that humans may experience more pain from not eating the pig than the pig does from being eaten. It is the unintended consequence of such reasoning that, if this is true, Americans may be *ethically required* to eat humanely raised meat to avoid experiencing the pain that comes from abstinence. This is certainly not what Singer would want to say so it would be better for him if he could establish that pigs have some interests beyond merely not feeling pain. He does attempt to do this but he goes about it in a way that leaves the door open for anthropomorphism which reduces the value of his claims.

I.3 The Second Problem – Anthropomorphism

In *Animal Liberation*, Singer attempts to tell us what interests and capacities some animals might have. This leads to a second problem with Singer's theory: pain perceptions are attributed based on anthropomorphic observations. Most of Singer's assessment of pain comes from observations about animal behavior and extrapolations about what that behavior might mean in terms of mental experiences. To get a feel about what this might mean, I would like to present a case in which I will ask you to imagine that you are an ethical biologist that has just discovered a new creature called creature P. It is your job to determine the mental capacities of creature P so we know how to treat it. After observing creature P for some time, you notice that it often runs into objects but every time it does, it backs up, turns slightly and attempts to go forward again. Sometimes it takes creature P multiple times to get around an object but it almost always eventually succeeds. It appears that creature P must realize it has hit an immovable object and must try to turn to attempt to get around the object while maintaining as close to its original trajectory as possible. Thus, it backs up and turns only slightly before attempting to go forward again. In addition, when poked from behind, creature P accelerates forward quickly for a period of time and then gradually returns to its original speed. From these observations, we might conclude that creature P both attempts to navigate its environment (though it seems to have poor senses and continually bumps into things) and attempts to avoid predation by speeding away from potential predators.

All of these conclusions, however, are incorrect except on the most generous picture of intentionality (one where things such as thermostats are intentional). Creature P has actually been discovered and the behavior mentioned above actually happens. Creature P is really the single-celled creature, known as *Paramecium,* which is considered to be a model organism for studying biology in high school and beyond. As it turns out, all the "intentional" behavior that can be

witnessed in *Paramecium* can be fully explained in terms of very simple, machine-like processes as observed by biologist Claude Andrivon. When *Paramecium* runs into an immovable object, receptors in the cell membrane open and briefly allow calcium ions to enter the cell. The calcium ions cause the cilia (hairlike projections that act as oars) to reverse so *Paramecium* reverses direction and backs up. Once *Paramecium* is no longer touching the object, the calcium channels close and the extra calcium ions are removed from the cell body, which causes *Paramecium* to swim forward again. The changing in direction paired with the oblong shape of *Paramecium* causes it to turn slightly as it begins to go forward again. Thus, it will move forward at a different angle than it backed up with. Similarly, when the *Paramecium* is touched from behind, touch-sensitive potassium channels open and allow potassium to enter the cell. The presence of the extra potassium ions cause the cilia to beat faster which makes the cell appear to "sprint" forward until the extra potassium is once again removed from the cell body by special ion pumps (Andrivon, 1988).

As this example demonstrates, what can seem to be examples of behavior that may be indicative of cognitive capacities (in this case, navigation and avoidance which could be evidence for basic decision making), can sometimes be explained with no reference to the mental life of the creature. In the case of *Paramecium,* there is almost certainly no mental life to speak of considering the creature consists of a single basic cell. It may be tempting to dismiss this extended example as simply "bad science" and claim that the initial conclusions I drew about *Paramecium (*that turned out to be false) were unfounded and certainly not representative of what behavioral evidence actually could tell us. However, the risk of anthropomorphizing behavioral observations, as with *Paramecium,* is great enough that it would be best to avoid founding our understanding of animal cognition on behavioral evidence.

In the case of *Paramecium,* it might be accused that I was too ready to anthropomorphize in order to get the conclusion (making incorrect observations) that I wanted. Of this, I may be partially guilty. However, no deceit was intended and we make routinely make assumptions very similar to the ones I supposed. For example, it seems *obvious* that if an animal vocalizes or jerks away from a stimulus that would cause pain in humans, that animal must be in pain. As is turns out, responses (vocalization, withdrawal) are processed in a completely separate neural circuit than pain experience. For example, when you place your hand on a hot stove, your body registers the heat and reflexively withdraws your hand before your brain ever gets the signal that your hand was on something hot. This is because reflexes work by sending signals to the spinal cord which are then relayed right back to the muscle cells to cause your hand to pull away. On the other hand, the experience of pain must be sent through the spinal cord and through various processing centers in the brain before you realize that you ever had your hand on the burner. You might imagine that some animals could have been created such they only had the reflexive half (and yelp and withdraw from painful stimuli) of this circuit but never receive any perceptions. This is similar to Cartesian thought which arguably regards animals as mere automata (Descartes).

Singer, however, tends to take the opposite end of the spectrum than Descartes. Where Descartes thought behavior could be explained fully by appeal to mechanic workings, Singer seems to think that most behaviors are representative of underlying mental states. That is, when an animal yelps, the yelp is representative of the mental state of pain. When in doubt about whether an animal feels a pain, Singer argues we should treat the animal as if it does (1995, p 174). This is a perfectly logical step to make ethically because it would be a horrible mistake if we treated an animal as if it couldn't feel a pain when it actually could. When only looking at the

ethical side of things, it seems much better to give moral consideration to something that doesn't deserve it (*Paramecium*) than to fail to give consideration to things that do deserve it (humans). Obviously, *Paramecium* does not deserve consideration and humans obviously do but that isn't to imply that there aren't things besides humans (namely, many animals) that also deserve consideration.

However, there is also a consequence for "hyper-extending" moral consideration to creatures that do not deserve it. On a utilitarian framework, an action is ethical just in case the results of that action are better than the results of alternative actions. On interest based utilitarianism, better means that more interests (and the more important interests) are satisfied, on balance, for the beings involved. For example, it is not ethical to eat factory farmed meat because the desire to eat meat is less important than the desire of animals to avoid the pain of factory farms when the two desires are compared. Similarly, in the classic utilitarian trolley cases, the right decision is to divert the trolley away from five people so that it will hit only one person, all other things being equal. As these examples pick out, the property of being ethical is not intrinsic but is *relational* in utilitarianism. When we hyper-extend moral consideration to creatures that do not deserve it, we may well treat creatures that do deserve consideration inadequately. Imagine that we didn't know the science behind *Paramecium* and treated it based on our observations alone. It seems that *Paramecium* might avoid predators because it has interest in continued life. If this is the case, perhaps we should be hesitant to put chemicals in pools, build bridges, or treat our water supply to kill off organisms (such as *Paramecium)* living in it. In other words, human interests would have to compete with *Paramecium* interests. In some cases, such as putting chemicals in pools, human interests would likely lose. Since *Paramecium* actually isn't sentient,

when *Paramecium* “interests” beat human interests, humans are treated inadequately because they forgo their interests for the sake of a creature that actually has no interests.

To really drive home how giving too much value to something gives less value to the other things on a relative scale (analogous to our relative scale of ethical action) I will present an example. Imagine I have $10 in U.S. currency (enough to buy my lunch). However, I'm not familiar with the relative values for international currency so when you walk up and offer to trade me your 10 pesos for my $10, I might agree because it seems that the money amounts are equivalent (10 is 10) and perhaps I like the novel appearance of the pesos. Of course, you know that (at least currently) pesos are worth much less than dollars and your 10 pesos wasn't enough to buy a drink, much less a lunch. This situation is analogous with giving moral consideration. In my ignorance of international currency, I mistakenly attributed the pesos as much value as the dollars (because, after all, it appeared to be the same amount). Thus, by valuing the pesos more than they were actually worth, when comparing pesos and dollars, I gave the dollars relatively less value than they actually have. Similarly, in ethics, when we give consideration to things that do not deserve it, we give things that do deserve consideration relatively less. This comes into play when we perform our “utilitarian calculus” to inform ethical decisions. Of course, this currency example isn’t a direct parallel to giving moral consideration because currency cannot suffer. Therefore, when I fail to give enough value to the dollars, I do no harm to them. However, you might imagine instead of dollars, beings capable of being harmed were at stake. Just as it would be unacceptable to fail to give consideration to a sentient creature, it is also unacceptable to fail to give *enough* moral consideration to a creature that deserves it. When Singer hyper-extends moral consideration to creatures that do not deserve it, he gives relatively less, and therefore not enough, consideration to creatures that do deserve it.

I.4 Concluding Remarks on Singer

My intentions in this critique of Singer were not to belittle what he has accomplished in the realm of animal ethics. When Singer first wrote *Animal Liberation,* vegetarians were far less common and knowledge of how we use and abuse animals was minimal. Thus, Singer's primary accomplishment was to expose our animal exploitation and argue that we should stop doing things that are clearly wrong to animals. In the late 20th century, Singer's critique was more than sufficient to spearhead the animal rights movement. Now, in the 21st century, we have a much greater awareness of animal exploitation and many individuals and organizations are taking steps to reduce their dependence on inhumane farming methods. For example, free-range poultry and pasture-raised beef as well as antibiotic and hormone-free meat products are growing in popularity. However, this new wave of animal awareness ushers in a need for new ethics. The question is no longer whether we should eat factory-farmed meat. Now the question is if we should eat the variety of "humane" meat that is becoming more mainstream. Singer doesn't explicitly address these questions because factory farming was a much bigger ethical question when he was writing. Now, in order to give a modern take on animal ethics, I will present my neurophysiological theory of animal ethics. I hope you will find this theory stays true to the motivations behind Singer's account while having the additional power to deal with cases of "humane" meat.

Part II: A Neurophysiological Theory of Animal Ethics

After discussing two problems with Singer's theory that severely hinder its ability to be applied to practical cases, I would like to propose my own theory of animal ethics. This theory, which I call 'the neurophysiological theory of animal ethics' aims to use neurophysiology (the study of the brain's physical structure) to draw comparisons between the human brain and animal brains to lay the foundation for determining – with much greater precision – which mental capacities different kinds of animals may have. Because mental capacities are dependent on the physical structure of the brain, studying the structure is a good way to approximate the mental capacities an organism might have. Moral decisions about how to treat animals ethically should be based on a thorough understanding of the mental capacities of animals. This is because the possession of different kinds and qualities of mental capacities may well support differences in ethical treatment. Just so you, as the reader, will know how all the sections tie together, allow me to provide a quick roadmap for the rest of this paper. First, I will discuss the main methodological differences between my neurophysiological theory and Singer's theory to make explicit how the neurophysiological theory is able to distinguish more precisely between practical cases. Second, I will give a quick crash-course in neuroscience to explain, in general, how it is thought that the brain works to give rise to conscious experience and pain perception. Third, I will describe which animals have which mental capacities based on the current state of neuroscientific research. Fourth, I argue that the capacities that animals display correspond to three different levels of ethical consideration. Fifth, I will attempt to provide answers for the tough cases that Singer's theory struggles to answer. Finally, I will look to the future with a very brief discussion of potentially cruelty-free meat and closing remarks.

II.1 Methodological Differences between Singer's Theory and the NP Theory

The main difference between my neurophysiological (NP) theory of animal ethics and Singer's theory is that the NP theory is based fundamentally on biology while Singer's theory is based fundamentally on philosophy. In other words, for Singer, philosophy sets the foundation (give all sentient creatures' interests equal consideration) and then Singer employs science and behavioral observation to sort out what exactly giving equal consideration might mean in terms of treatment. In contrast, the NP theory uses neurophysiology to determine what mental capacities and interests animals have and then employs philosophy to sort out how we should treat animals with these particular capacities and interests. On the face of it, it might not be clear exactly why it makes a difference which one (philosophy or biology) we start with. However, it actually makes a great deal of difference as I shall explain.

Beginning within philosophy, Singer asserts that the way we should treat all sentient creatures is with equal consideration. This ethical maxim sets up a dualistic world, those creatures that are sentient (and receive equal consideration) and those that are not sentient (and receive no consideration). Given these two categories, we apply science and attempt to place creatures into one of the two categories. However, among sentient creatures there seems to be a great deal of difference. For example, both salmon and humans are sentient but it is dubious that we might compare interests between the two from a point of equal consideration. In other words, establishing ethical categories and then placing creatures into them homogenizes some of the important differences that are clear to biology.

My neurophysiological theory begins with biology (neurophysiology) in order to establish biological categories based on mental capacities. Because ethical consideration should be given based on a creature's capacities, it seems most logical to determine those categories first. After establishing biological categories based on mental capacities, we should give each category the ethical consideration it deserves. Because the categories all correspond to a different set of mental capacities, *each category will receive different ethical consideration*. I identify three biological categories (though science in the future may allow more to be identified to yield an even more precise ethical system) that correspond to three ethical categories. Starting with biology, I am able to break Singer's large ethical category of "sentience" down into three subcategories which allows my neurophysiological theory to offer a much greater degree of precision when comparing creatures that fall into different categories (but would have both been in Singer's single category). This is important when it comes to treatment. Treatment should be the final result of ethical consideration, however, in certain cases, ethical treatment is hard to determine from a point of equal consideration. For example, when we give cows and fish equal consideration it is hard to determine which treatment is more wrong when it comes to cow-fishing or standard (fish) fishing. For fishing, which is more wrong matters little (because we do not cow fish) but the cow-fishing case is a close parallel to eating beef or eating fish. This is a case that we will be better suited to judge after I present my neurophysiological theory.

Though Singer embraces an interest-based form of utilitarianism, the primary interest Singer focuses on is the interest of avoiding pain (and correlatively, the interest of experiencing pleasure). I will follow suit and limit my scope to the discussion of pain and pleasure. Given that the overall purpose of this paper is to discuss meat-eating, mental capacities which result in interests of avoiding pain are particularly salient because generally being raised for meat is a

painful process for the animals that experience it. My focus on pain is not to devalue other capacities that may be important for ethical consideration (capacities to form relationships, emphasize, give care, receive care, and doubtless many others) but to focus on these other capacities when examining our relationship with "food animals" is to ignore the elephant in the room: the pain we inflict upon animals when we raise them for food. Therefore, throughout my discussion of neurophysiological capacities and the subsequent discussion of ethics, I will focus on interests that are related to the perception of pain[6].

II.2 Basic Neurobiology

Many philosophers tell us why animal experience of pain may be different or, in some ways, the same as human experience of pain. However, they usually do so by citing a study that claims some animal behaved "as if" it experienced a pain in a way that a normal human might, but this doesn't really explain *why*. To someone with no background in neuroscience and biological methodology in general, citing these studies is roughly an appeal to authority (an authority that most readers won't have the scientific knowledge required to question). In an attempt to *explain* why different creatures experience different levels of consciousness, I will discuss, generally, how a brain works, and then turn to a model of consciousness described by neuroscientist Susan Greenfield.

The brain consists of many cells (called neurons) that regularly communicate with one another. They do this by sending electrical signals (action potentials). When one neuron sends a signal to another, it will cause changes in the electrical potential of the second neuron. If these

[6] Thanks to Rebecca Walker for the discussion about ethically relevant capacities that led to this paragraph.

changes are large enough (and of the right polarity) the second neuron will fire an action potential to a third neuron in the chain and so on. Each neuron is interconnected with many others so, at any given time, each may be receiving lots of input which all sums together and contributes toward changes in the electrical potential. Thus, if a group of neurons becomes very excited and begin firing action potentials rapidly, they could excite many other neurons which, in turn, could excite even *more* neurons. A group of neurons firing at the same time is called an assembly. Very oversimplified, consciousness is having a neuronal assembly that integrates enough (and the right kinds of) neurons. That is, the physical root of conscious experience is a group of neurons integrating information. The larger the assembly and the more interconnected its member neurons, the greater the chance that it will recruit other neurons, and the greater the chance that it will result in conscious perception (Mashour, 2010).

This is the mechanism for consciousness as supported by Susan Greenfield. She characterizes the ability of a group of neurons to excite many other neurons as a "stone in a puddle" (Greenfield, 2012). When a stone is thrown in a puddle, there is a splash at the site of impact and then the formation of ripples that spread out and gradually become less pronounced the further they get from the impact. The ripples in this analogy represent the far reaching effects that heavily stimulating a single area has on the formation of a neuron assembly. The size of the stone represents neural connections. More connections is analogous to a bigger stone which means a larger in magnitude and more widespread effect (in terms of both puddle ripples and neuron activation). The velocity of the stone represents the initial stimulus. A more powerful stimulus is analogous to a stone that is thrown faster which contributes to a larger in magnitude and more widespread effect.

Across species, there is a marked difference in the degree of interconnectedness of the brain (size of the stone). (Even within species, different individuals have slight variations as new connections are made to physically represent memories and other environmental conditions.) This means that different species will handle stimuli differently. In the case of pain, the initial stimulus is the firing of nociceptors at the site of inflammation. The intensity of the firing of nociceptors determines the effect the initial stimulus will have on a select group of neurons responsible for monitoring the particular nociceptors that are firing. If the nociceptors fire rapidly, the corresponding neurons become very excited (throwing a stone in a puddle at high velocity) and have a stronger effect on other neurons than if the nociceptors fired more slowly. However, the effect the initial neurons can have on others is entirely dependent on the connectedness of those neurons because each neuron can only exert an effect on a neuron it is directly connected to.[7] Thus, even an intensely firing group of neurons (corresponding to serious trauma picked up by nociceptors) would fail to excite other neurons if the group was not properly connected. In a situation like this, the creature would not consciously experience pain even though it certainly would have if its neurons were properly connected.

However, once the minimal neural organization for basic consciousness is achieved, it is more accurate to think of consciousness as a spectrum than as just a switch that is either on or off. It may be helpful to draw an analogy between consciousness and color vision. Spiders can see ultraviolet and green; reptiles can see infrared and some color; rabbits can see blue and green; and humans can see the "rainbow" spectrum of color (Cooper, Kazilek, 2009). It would seem absurd to say that only humans can see in color, but we would also lose valuable

[7]Admittedly, this is oversimplified as a number of neuromodulators and other factors are involved as well, but for all practical purposes, all of these can be lumped into a broader category of general connectedness as done in this paper for simplicity's sake.

description if we only said all the aforementioned creatures see in color. Rather, it would be most accurate to say that humans possess color vision *to a greater degree* than the other animals on the list that possess some form of color perception (i.e. we see *more* colors even though some animals see colors we do not). Similarly, sentient beings all possess different parts of the mechanism that projects what we call consciousness, but it would be wrong to say that some are consciousness while others are not. Therefore, the traditional notion of consciousness as being vastly different in kind among various creatures is likely false. This is not to say that all conscious experience is the same but only that the foundations of consciousness is conserved among all conscious creatures. However, as you progress along the spectrum, some additional mental capacities are obtained and foundational ones become more defined. Some of these additional mental capacities are ethically relevant which requires us to give different consideration to creatures that have them than to creatures that don't. Keeping this in mind, let us turn to science to attempt to lay out the spectrum of consciousness.

II.3 The Brain and Pain

So far we have talked only generally about consciousness, but we also need to discuss the neurophysiological basis of pain before we can address differences in animal capacities. A non-technical (at least in the biological sense) definition of pain is something like "an aversive conscious perception of a stimulus usually associated with actual or potential bodily harm." According to this definition, pain involves at least two components: (1) a conscious sensory perception and (2) an aversive reaction to this perception. It is commonly thought that these two parts cannot be separated from each other because pain is necessarily aversive. However, it is

known that patients given morphine often report that the pain has not stopped but *they do not seem to mind it.* This suggests that, under certain circumstances (taking morphine at least), the human perception of pain can be dissociated into its constituent parts. As it turns out, this makes sense neurophysiologically speaking, for the brain circuit that processes the sensory component of pain is different than the circuit that processes the aversive reaction (badness) to pain.

The part of the brain that processes the sensory component of pain is called the sensory (lateral) pathway. In this pathway, nociceptors project to the lateral thalamus and then are rerouted to the somatosensory cortex (processes touch sense information) (Demertzi et al. 2013). It is within the cortex that sensory information is made conscious. In contrast, the part of the brain that processes the badness of pain is called the affective (medial) pathway. In this pathway, nociceptors project to the medial thalamus and then are rerouted to the limbic system (amygdala, anterior cingulate cortex, and insular cortex) (Sun et al. 2008). Thus, you might imagine that it would be possible to experience the sensation of pain without the badness or vice-versa, dependent on which pathway the nociceptors activated. In fact, morphine is an opiate and the medial (affective) pain pathway has many more opiate receptors than the sensory pathway (Shriver, 2006). Therefore, morphine might inhibit the affective pathway while leaving the sensory pathway roughly untouched which might explain why patients sometimes report that they feel pain but do not mind it. This is in contrast to the usual conception of pain where it must be aversive or it is not pain. In terms of the usual conception of pain, you might say morphine patients experience a perception of nociception but, properly speaking, not the full qualitative state of pain. The separation of the sensory and affective component of pain might be at the molecular level in addition to the neuronal level. One group of researchers have isolated a

protein, P311 that is required in areas of the brain associated with pain affect but not required for normal sensation (Sun et al. 2008).

II.4 The Capacities of Animals

In this section, I will discuss the differences between capacities of different kinds of animals while paying special attention to the animals humans normally eat. This set of animals includes primarily: crustaceans, fish, chickens, turkeys, cows, and pigs. These animals are of the most concern here because they are the ones that are, arguably, the most taken advantage of. Furthermore, whether or not to eat animals is an ethical choice with practical requirements that are clear and accessible unlike other ethical commitments to animals such as reducing environmental pollution to save animal habitats where practical requirements may be unclear or impossible (it may not be possible for many people to not drive a car, etc.). I will start from the simplest neural organization and move to the most complex. Complexity will be determined by a host of factors including: overall neural organization, development of specific brain regions, and number of neurons. For simplicity's sake, I won't deal with individual species for the most part, but with taxonomic groups. This is because the individual species within each taxonomic group generally have very similar capacities. However, there are some well-known exceptions that I will mention. Also, again for the sake of simplicity, the results I present in this section are only a summary of the data that led me to these conclusions. A more complete picture can be obtained by reading the sources from this section.

II.4.a Invertebrates

Invertebrates rank the lowest on the spectrum because, in general, they have nervous systems that are very simple with few neurons. In addition, their nervous systems are arranged in clusters of ganglia (groups of neurons) rather than a massive ganglion (the brain). For example, many invertebrates have a separate ganglion used from innervating each limb. The resulting neuroarchitecture resembles a rope ladder with a pair of ganglia at each rung of the ladder (corresponding to one per limb on each side of the body). These ganglia are not interconnected to the same extent as vertebrate brains are, and this reduces their ability to form neuron assemblies for consciousness. The simplest nervous systems I will consider are bivalves (scallops, clams, mussels). They have only three pairs of ganglia which control only basic bodily functions (feeding, reproduction, etc.). Closely following bivalves are gastropods (snails, slugs). Gastropods have up to 6 pairs of ganglia that innervate chemoreceptors and mechanoreceptors all over their body that monitor basic bodily functions (preceding information: Roth, 2013, p. 91). However, typical gastropods may have more neurons innervating their foot than are in charge of more cognitive functions (Cash & Carew, 1989).

Within invertebrates, Crustaceans (in the same category as insects and spiders) have relatively advanced nervous systems. They have fused several ganglia into one large ganglion in addition to maintaining the rope-ladder body with smaller ganglia located at the legs. This fused ganglion allows for a greater degree of connectivity than could be achieved in bivalves or gastropods. The crustacean nervous system contains relatively few neurons though it still has more than bivalves and gastropods.

Cephalopods (octopus, squid, and other related creatures) have nervous systems that are far beyond most (if not all) other invertebrates. It is very unclear where to put cephalopods on the mental spectrum. Octopuses have around 550 million neurons, 26 million of which constitute a "vertical lobe" which is thought to be involved in higher processes (Roth, 2013, p. 94). However, the cephalopod brain is so different in structure from vertebrate brains that it is difficult to even compare the two. Because of this, I won't attempt to discuss cephalopods in this paper but several other authors claim that octopuses, squids, and other cephalopods are highly intelligent, possibly rivaling mammalian intelligence (Finn, Tregenza, & Norman, 2009).

II.4.b Vertebrates without Association Areas

The transition from invertebrates to vertebrates marks a huge leap in neuronal organization (perhaps the biggest on the spectrum). Where invertebrates had many ganglia, vertebrates fuse all the ganglia into one larger ganglion (the brain). Thus, early vertebrates are some of the first creatures with a central "hub" of information processing. Centralized information processing increases the information processing *speed* between neurons and also the *interconnectedness* of the central nervous system. In addition, vertebrates generally have more neurons than invertebrates (Roth, 2013). These factors combine to allow vertebrates to form larger (and more frequent) neuron assemblies and they therefore have conscious perceptions.

Fish are the lowest vertebrates. They have relatively few neurons and generally do not have very complicated nervous systems. On average, they have about 1/15 the brain size of a similarly sized bird or mammal. They do possess a telencephalon (which is responsible for

higher-level processing in vertebrates), but, in fish, the telencephalon is concerned mostly with olfaction (Helfman, Collette, & Facey, 1997). Most of the sensory integration occurs in the midbrain which means that any conscious perceptions a fish might have occurs in the midbrain. In contrast, conscious perceptions in humans are through to originate from the telencephalon.

Amphibians have a very similar neuronal organization to fish. They both have rudimentary telencephalons that can process multimodal sensory information though these are more pronounced in amphibians (Roth, 2013, p. 151). Amphibian telencephalons begin to show signs of a developing pallium (higher cognitive center in sauropsids) but the pallium shows no lamination (layering) (Medina & Abellán, 2009). Thus, the midbrain is still the main processing center. As in fish, any conscious perceptions of amphibians would occur in the midbrain.

II.4.c Vertebrates with Association Areas

Evolutionarily, shortly after the appearance of early reptiles, the group diverged into what became modern-day sauropsids (reptiles and birds) and what became modern-day mammals. Sauropsids developed a three-layered pallium as the main cognitive portion of the brain and mammals developed a 6-layered neocortex as the main cognitive portion of the brain (Aboitiz, 1999). Layering of brain tissue allows more neurons to be packed into a smaller space and still be able to communicate with one another. Therefore, laminated brain regions are usually present in creatures with higher cognitive abilities.

Reptiles are the first class to show lamination of the pallium. In addition, more nerves route through the thalamus and project to the pallium and the dorsal ventricular ridge (DVR).

The DVR in reptiles is sometimes considered to be a potential homolog of the mammalian cortex, but many scientists deny the homology and claim the DVR is rather functionally similar to the amygdala (Medina & Abellán, 2009). A combination of lamination and the emergence of the DVR places reptiles a fair bit above amphibians on the spectrum.

Birds maintain much of the neuroanatomy of reptiles. However, in birds, the cerebral hemispheres are much larger and birds have developed an area called the hyperpallium in addition to the DVR. The bird hyperpallium is not laminated but it does show dense clusters of neurons that may serve the same function as lamination (Medina & Abellán, 2009). Thus, birds have multiple brain regions with ties to higher cognitive functions. Within birds, galliforms (chickens, turkeys) have the least developed brains while songbirds and corvids (jays, crows, magpies) have the most developed. Corvids are thought to be as intelligent as at least some, but perhaps many, mammals (Butler & Cotterill, 2006).

Mammals, as mentioned above, have a 6-layered cortex which is responsible for sensory processing and higher-level cognitive functions. Mammals have centers for memory and emotion (hippocampus and limbic system) to a greater extent than any other class. In addition, mammals have brain regions that are missing in even the closest competitors (birds). These brain regions, the claustrum and the neocortex, contribute to the complexity of consciousness, but are not essential for basic consciousness (Butler & Cotterill, 2006). Thus, mammals can recruit neuron assemblies more frequently and to a greater extent than other classes. This causes mammals to have more, and more vivid, conscious perceptions which results in generally more complex behavior than is exhibited by other creatures.

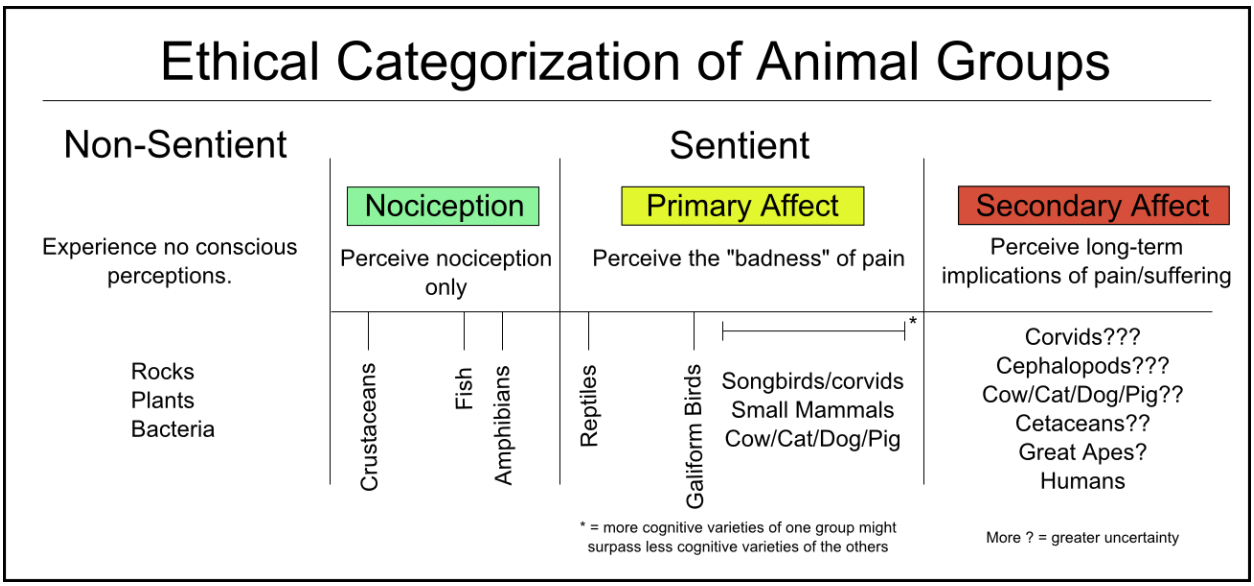
Within mammals, primates are notable for having larger brains than most of the other species in the class. In addition, some structures thought to be important for particular forms of cognition are unique to primates. Primates possess phylogenetically new connections from the pathway carrying nociceptive information (lamina I) to a so-called "interoceptive cortex," a cortical structure within the lateral sulcus that has rich connections with the anterior cingulate cortex and amygdala which play a large role in the generation of emotions (Craig, 2003). In short, primates have a much greater capacity for interoception (basically a mental representation of bodily states) than non-primates. This is somewhat comparable to a representation of "self" that some philosophers speak about. In non-primate mammals, there is no interoceptive cortex. This suggests primates can achieve a greater degree of consciousness than other creatures and can represent nociceptive and emotional states with a degree of self-consciousness. Humans, obviously, have full self-consciousness and meta-thoughts and the full suite of cognitive abilities. The direct implications of this additional self-awareness on the perception of pain states will be discussed at the end of the next section.

II.5 Pain Capacities

Now that we have most animal classes laid out along a spectrum in order of ascending cognitive ability, it is time to attempt to group these biological categories into ethical ones in order to provide practical guidelines for which kinds of minimal ethical treatment we should give to each class. While all the creatures on the spectrum differ only in degree with respect to their consciousness, it seems like there are a few places where the difference between classes is more significant than in others. That is, for ethical purposes, there seem to be a few places along the

spectrum where differences in degree of consciousness manifest themselves as differences in kind of ethical consideration.

The first major difference can roughly be located between invertebrates and vertebrates, and a second one can be found between animals that possess association areas and those that possess no association areas. In addition, there is a third distinction that I would like to make, but note that it is much more subtle than the first two. For somewhere around primates/humans, there are additional brain regions that other mammals do not have, and furthermore, there is a wealth of behavioral evidence to support the idea that the primate/human brain is capable of things that others are not. Of course, we cannot base our judgment of what kind of capacities different mammals might have on behavioral evidence alone. This means that if we cannot find a neurophysiological basis for the differences observed, then the NP theory won't be able to account for the difference in behavior. First, I will discuss the vertebrate-invertebrate distinction and then I will discuss the association area-no association area distinction. Finally, I will expand upon the potential neurophysiological basis for the cognitive differences observed in humans (and other primates) that I briefly mentioned in the previous section. To give a glimpse into the product of the previous section and this one, below is a figure that summarizes which animals fit into which ethical category based on their place in the spectrum of consciousness.



II.5.a Vertebrate-Invertebrate Distinction

As mentioned above in section *II.5*, vertebrates generally have a significantly greater ability to form neuron assemblies than invertebrates. This is because neurons have been consolidated from many distant clusters to one big cluster. Sensory information in invertebrates is mainly processed by local ganglia rather than by being sent to a central hub. These local ganglia are thought not to have a sufficient degree of organization required to generate a large enough neural assembly for consciousness. Therefore, most invertebrates are not able to consciously experience sensory information. Thus, according to the NP theory, most invertebrates are not sentient and therefore do not have any interests.

However, one notable exception to this rule is crustaceans, for the neurophysiological evidence is ambiguous on the question of whether or not crustaceans are sentient. They do have fused ganglia that act as a primitive "brain" (like the one that is found in vertebrates), which is capable of generating a larger neuronal assembly than dispersed ganglia. It isn't clear exactly

what size of assembly is required for conscious perception to be possible, so it isn't clear whether crustaceans fall above or below the threshold. Because the neurophysiological evidence is ambiguous, I will turn to some of the more reliable behavioral evidence (that from competent scientists). If we recall, the main reason for denying behavioral evidence was the degree of anthropomorphism that tends to be incorporated. However, once we use neurophysiological evidence to establish a framework of cognitive capacities, behavioral evidence can be very useful to fill in the details. In other words, it is acceptable to admit behavioral evidence *in support of* neurophysiological evidence though not *in place of* neurophysiological evidence.

Behavioral evidence presented by Robert Elwood claims that shrimp attempt to rub chemicals that are painful to sentient creatures off their antennae (Elwood, Barr, & Patterson, 2009). This indicates that shrimp can, somehow, detect the presence of the chemicals in order to engage in the behavior of rubbing them off. However, this does not necessarily imply that shrimp detect anything consciously; they may just respond to the chemicals through some sort of reflex. For instance, even people that are sleeping (and presumably have no conscious perceptions of throat sensations) will reflexively cough to clear their throats. Crabs, on the other hand, can learn to avoid places where they have previously experienced painful stimuli (Denti, Dimant, & Maldonado, 1988). In the study done by Denti and colleagues, researchers gave crabs a choice between two "dens" (rock caves). After entering a cave, some of the crabs were shocked. Crabs that were shocked left the den in which they were shocked in favor of the other (a risky move because it involved crossing an open space that could have been patrolled by predators). In contrast, crabs that were not shocked remained in the original den. The crabs were then removed from the tank for a few hours (and placed a different tank) after which time, the crabs were returned to the test tank. When returned to the test tank, crabs that were shocked picked the cave

in which they were not shocked. Apparently, crabs avoided the cave they were shocked in for up to 24 hours. The crab study is much more suggestive of sentience than the response elicited by shrimp because, in the crab study, the crabs can't have been merely responding to stimuli. This is because when the crabs responded by avoiding the cave in subsequent trails, there was no stimulus present to respond to.

Merely responding to stimuli is something that many non-sentient things do. For example, some plants will curve towards sunlight, *Paramecium* can respond to objects in its environment, and even thermostats respond to the temperature of a room to regulate the amount of time the air conditioning is on. In all these cases, something responded to a stimulus but we would not consider any of them as sentient. Therefore, it seems that behavioral evidence of sentience requires more than the mere ability to respond to a stimulus. However, the crabs in the study reacted to a *past* stimulus. This implies the crabs learned where they might experience the negative stimuli and subsequently avoided it. This kind of behavior isn't possible with mere stimulus-response behavior because the stimulus isn't present at the time of response. As Elwood argues, stimulus-response behavior facilitates the short-term (while the stimulus is present) avoidance of noxious stimuli and remembered sensory perceptions facilitate the long-term (after stimulus ends) avoidance of noxious stimuli (Magee & Elwood, 2013). Avoidance learning (as demonstrated in crabs) is a type of long-term avoidance which is indicative of sensory perception in crabs.

Still, avoidance learning does not entail consciousness. The shocks the crabs received may have created procedural memories in the crabs. These memories, even in humans, are not conscious. An example of a procedural memory is the ability to use a fork to eat. Once a person

learns how to use a fork, they do not have to consciously perceive their actions in order to properly use the fork. It is possible that maneuvering to avoid the shock (as it is administered) could trigger the formation of a procedural memory in the crab. In this process, the crab might learn which side to go to in order to avoid the shock. On subsequent trials, the crab might go to that side as a function of the procedural memory rather than the recollection of a conscious memory. This entire process could happen without any conscious perception.

However, the unconscious procedural memory pathway would look exactly the same as the conscious sensory memory pathway from both a behavioral and a neurophysiological standpoint. The only difference is that one is indicative of a creature that requires ethical consideration and the other is not. In the face of such ambiguous evidence, it is better to give the crab consideration. Note that this move is not equivalent to Singer's over-extension of moral consideration, since my neurophysiological theory only extends "doubt consideration" to the group of creatures directly on the border of sentience. Furthermore, the degree of consideration these creatures receive is small enough that many of the relative scaling issues that Singer's theory encounters are minimal on the neurophysiological theory.

Turning from crustaceans, fish and amphibian (early vertebrate) brains are similar enough that I will consider them together. In fish and amphibians, the presence of a consolidated brain provides evidence that fish and amphibians might have conscious sensory perception. The much greater degree of development in early vertebrate brains than in crustacean brains is indicative of a minimal level of consciousness. With vertebrate morphology the neurophysiological case for conscious is much clearer than with crustaceans. However, this neurophysiological evidence is

also supported by behavioral evidence of a similar kind as the crab study (Allen, 2013). Once again, avoidance learning is indicative of sensory perception rather than mere stimulus-response.

In conclusion, crustaceans and early vertebrates are capable of sensory perception. Of course, the cephalopod family of creatures is almost certainly sentient as well, but their nervous systems are so complex, yet dissimilar, from humans that little can be said in terms of what capacities they actually have.

In my discussion so far, you may noticed that I have been very careful not to say that crustaceans and the earlier vertebrates actually feel pain. Precisely what these animals feel is the conscious perception of nociception. This is distinct from what people usually mean when they say "pain." Pain implies both a conscious perception of a painful stimulus and an associated badness or negative feeling that comes with that perception. However, as mentioned in the general discussion of brain function, stimulus perception and attribution of meaning are two different steps. Perception is done in the sensory areas and attribution of meaning is done by associating the stimulus with memory and emotion in association areas (amygdala, anterior cingulate, etc.) of the affective pathway. Early vertebrates and crustaceans do not have the association areas because much of their brains is focused on basic sensory perception and reaction. Though these creatures can remember their sensory experiences to at least some degree (though not in the same way that you and I can remember), they lack the emotions that contribute to the affective pathway of pain. Therefore, crustaceans and early vertebrates experience "painful" stimuli as only the sensory aspect of pain. Creatures that can only experience the sensory aspect of pain will be said to experience only *nociceptive sensation*.

II.5.b Association Area Distinction

As mentioned above; crustaceans, fish, and amphibians experience nociceptive stimuli as only sensory perceptions that lack an affective dimension. This is because the aforementioned creatures lack the association areas required for evaluating the badness of pain. Reptiles, birds and mammals all have association areas, though to different degrees. The reptilian DVR is thought to be a primitive but functional homolog of the mammalian amygdala (Medina & Abellán, 2009, Loc. 79). In humans and other mammals, the amygdala is associated very strongly with the experience of fear and other emotions (LeDoux, 2000, Loc. 122). Therefore, it is likely that reptiles can experience basic emotions, especially (and perhaps only) fear (Grandin & Johnson, 2006, p. 93). The result is that when a reptile processes nociceptive stimuli, it not only processes the sensory component but also routes the information through the DVR where basic emotional processing takes place. Reptiles can derive some of the "badness" of pain that humans experience by experiencing pain partially as fear.

Birds have greatly enlarged telencephalons that allow them to process multimodal sensory and limbic associative information. Scaling for a birds smaller body size, the bird brain is around 6-10 times larger than the reptile brain (Roth, 2013). In addition, the avian hyperpallium is a basic functional homolog of the mammalian cortex and both derive from the dorsal pallium (Medina & Abellán, 2009). The cortex (and so the hyperallium) are important for recurrent connections. Recurrent connections from the cortex back down to the limbic areas help to assign meaning (through the expression of emotion) to a given stimulus (Roth, 2013, p. 290). The recurrent connections that are active in birds (and to a much lesser degree in reptiles) help

them consciously associate pain with badness. Because birds possess a much greater degree of neural development than reptiles, birds experience the same type of perceptions but to a much greater degree. In practice, this may mean birds experience a wider range of more vivid emotions than do reptiles.

Mammals have the full processing suite for pain. The amygdala, anterior cingulate cortex, and insular cortex (members of the limbic system) all play a role in establishing the badness of pain. Recurrent connections from the cortex to the limbic system (cortico-limbic projections) also help activate the limbic system in response to nociceptive stimuli. In addition, the brains of mammals have additional processing centers as compared with the brains of birds (Butler & Cotterill, 2006). These factors come together to suggest that mammals experience the badness of pain to a greater degree than birds. However, the line between birds with larger brains (magpies, crows) and mammals with smaller brains (shrews) is blurry because avian and mammalian brains have a very different structure. Creatures that can experience the badness of pain through emotional processing will be said to experience the *primary affective* dimension of pain.

II.5.c Secondary Affective Dimension of Pain

Finally, there is a division between the mental capacities of humans/primates and the mental capacities of other mammals. This division is a bit more "mysterious" than the other two because it isn't yet clear what the neurophysiological basis for the observed differences are. As mental capacities become more complex, more brain regions are involved which makes it difficult to pinpoint any group that is essential for the function. Humans (and possibly primates

and others) can perceive the significance of a perception to the self as a whole. For example, when I perceive my ankle hurts I immediately assess how bad the pain is, if it is indicative of a sprain or fracture or just a nagging ache, and how all of this will impact my basketball game tomorrow. Therefore, a simple perception of ankle pain can manifest itself as concerns for my overall wellbeing and future hopes and plans. Creatures that can experience the badness of pain through long-term considerations about the implication of pain as will be said to experience the *secondary affective* dimension of pain.

Though it is difficult to pinpoint the neurophysiological basis for the secondary affective dimension of pain, (and why there is no evidence of it in many other mammals) there are some suggestions. Primates possess brain connections that no other creature possesses. Neurons carrying information about nociceptive information project to a region that has been called the interoceptive cortex which is thought create a kind of map of bodily emotional states. The interoceptive cortex also has many connections to the anterior cingulate cortex and the amygdala (Craig, 2003). In a very non-technical way, this could mean that, in primates, emotional responses to bodily states – including pain – are made conscious and processed (by the interoceptive cortex) and the results of this processing are sent to emotional centers (anterior cingulate cortex and amygdala) where an emotion is connected. Thus, my interoceptive cortex (and other cortical regions) may be active when I am considering how my hurting ankle will affect me and the disappointment that I experience when I realize I might not be able to play in my basketball game is the result of the activation of emotional centers in response to this realization. Of course, this is all a gross oversimplification and speculation meant only to help put abstract neurology into a more concrete form. In reality, all that can be said for sure about the

interoceptive cortex is that it is "activated in a graded manner by noxious stimuli" and activation of the interoceptive cortex is correlated with subjective feelings in human subjects (Craig, 2003).

Other researchers have suggested that secondary affect might be the result of the anterior cingulate cortex's interaction with the prefrontal cortex. In humans, the prefrontal cortex is associated with higher cognitive functions such as self-control, goal oriented behavior, and characteristics of personality. (Salzman & Fusi, 2010). On this view, the anterior cingulate cortex might process nociceptive information in parallel with the prefrontal cortex to ascribe long-term meaning to nociceptive information. On either this view or the interoceptive cortex view, primates have a much greater capacity for secondary affect than non-primates and humans have a still greater capacity than non-human primates. I do not intend to conclusively state that non-primates do not experience secondary affect because secondary affect could be multiply realizable. Corvids such as ravens and magpies and cetaceans such as dolphins seem to be strong candidates for creatures that might experience secondary affect without primate neural architecture. Additionally, it may be that some of the more intelligent mammals such as pigs, dogs, or cats can experience some degree of secondary affect though they lack major brain regions that appear to be relevant in humans. However, the portion of the human brain dedicated to the experience of secondary affect seems to be much larger than anything that might be sported in other creatures. Therefore, it seems pretty safe to assume that humans experience the secondary affective dimension of pain to a greater degree than other creatures, as is strengthened by the lack of behavioral evidence to suggest otherwise.

Part III: Ethics

In summary, bivalves like clams and oysters aren't capable of experiencing conscious perception and, therefore, aren't sentient. Singer, too, endorses this conclusion in *Animal Liberation* (1995, p. 174). Crustaceans are *probably* sentient and experience minimal nociception as sensation only. Fish and amphibians experience nociception only as sensation but to a much greater degree than crustaceans. Reptiles minimally experience the primary affective dimension of pain which involves associating the sensory component of pain with badness through associative pathways. Birds experience the primary affective dimension of pain to a much greater degree than reptiles, and mammals experience it to a greater degree than most birds. Finally, even though the scientific evidence is not yet conclusive on the issue, it is thought that only a select few creatures experience the secondary affective dimension of pain which is characterized by the consideration of the long-term, temporal implications of pain. This dimension may be limited to humans only or it may extend to primates and cetaceans (dolphins), but almost certainly seems to be limited to creatures with unusually superlative brains. For the purposes of this paper, I will assume that the distinctions made above are correct and will use them as a physiological foundation for the theory of animal ethics to be developed in the sections below.

Now that we have a better understanding of exactly which capacities different kinds of animals have, the neurophysiological theory can give us a more precise grounding of the relative ethical importance of the three classes among sentient beings (non-sentience still is ethically inconsiderable). Because each of the classes adds an additional group of mental capacities to the previous class, the hierarchical order of ethical importance of the classes is clear. For example,

creatures that experience primary affect also experience pain as sensation. Creatures that experience secondary effect also experience primary affect and pain as sensation. Starting from the least ethically considerable class and moving to the most ethically considerable class, the three different 'moral groupings' are: those who only experience pain as sensation, then those who in addition experience primary affect, and finally those who also experience secondary affect. However, this is still only a rough classification: for we have slightly different ethical responsibilities to creatures within each class based on individual differences in capacities.

III.1 Sensation of Nociception Only

Our ethical responsibilities to creatures that only experience the sensory component of pain are relatively low. This is because sensory experience, in lieu of negative interpretation, has no great qualitative effect on the mental state of the organism that experiences it. The reason we consider pain so ethically considerable is because pain is a negative mental experience. When you feel pain, *it hurts!* Therefore, creatures that experience pain necessarily have an interest in avoiding it. However, creatures that experience pain only as sensation do not experience pain as qualia. For instance, creatures that experience only sensory perceptions will experience nociceptive sensation much in the same way as humans experiences the light touch of a finger on the back of the opposite hand: although one clearly perceives the presence of the finger, there is no emotion – either positive or negative - associated with it. This perception of touch is a useful perception nonetheless, because it tells us that we are in contact with something and this allows us to respond appropriately to the world around us. Nociceptive sensation likely serves a similar purpose in animals. When the animal experiences the phenomenal aspect of the firing of

nociceptors, it can respond appropriately to whatever is harming its body, which will usually involve avoiding the stimulus. In addition, in some organisms, nociceptive sensory stimuli are remembered though persisting physical changes in brain chemistry and physiology and consequently avoided in the future. All of this (useful behavior) can be explained without attributing any further sense of badness to nociceptive perception.

Though the sensory experience of nociception is useful for the animals possessing it in terms of their survival, it does little to motivate ethical consideration. As mentioned above, we are concerned with a creature's interests. It seems improbable that a creature that cannot experience badness has a morally relevant interest in avoiding the sensation of nociception. If the creature has no interest in avoiding the sensations, there doesn't seem to be anything to care about ethically from a consequentialist perspective. This is mostly true. However, we do have some *weak* responsibilities to creatures that experience the sensory component only. Despite the fact that these creatures feel no pain, they still avoid noxious stimuli. Therefore, there must be something aversive about nociceptive sensation for these creatures (otherwise, they wouldn't avoid it). Obviously, their avoidance isn't caused by the "badness" of pain as experienced by more cognitive creatures but rather by some metaphysical aspect of nociceptive sensation. It is difficult to imagine how this might present itself in creatures that experience only nociceptive sensation. It may be that creatures are instinctively "programmed" to avoid nociceptive perceptions.

This might be comparable to how humans instinctively dislike things that taste bitter[8] (which is indicative of poisons in plant material) and instinctively enjoy the taste of sweet things

[8] Some people eventually enjoy things that taste bitter, such as coffee but this is almost always an acquired taste. Small children given bitter things usually find them (instinctively) unpleasant tasting.

(indicative of energy stored as sugars) such as fruit. Because creatures that experience nociceptive perceptions instinctively avoid them, it is implicit (through instinct) that the creature has an interest in avoiding the experience of those perceptions. In other words, the implicit instincts of sensory-only creatures do the same work that the experience of 'badness' does in creatures that experience the affective pathway. This is different than the "interest" plants might have in being in the sun because nociceptive perceptions are conscious events that are then acted upon. Therefore, we have a similar responsibility to sensory-only creatures that we have to creatures that experience the badness. However, because the aversion is implicit rather than explicit (as in emotional creatures) we have a much weaker responsibility. The responsibility we have to sensory-only creatures is to avoid causing them to have nociceptive perceptions, which they instinctively avoid. In abstract, this means that we should not do things that appear to cause "pain" to crustaceans, fish, or amphibians. Of course, in practical cases, whether or not we should honor our abstract responsibilities depends on the circumstances of the case as I will discuss in the final section when I turn to some practical cases.

III.2 Primary Affect

The primary affective dimension of pain includes what is very close to the intuitive definition of pain. This is because the primary affective dimension of pain is roughly the badness of pain. Thus, creatures that experience the primary affect of pain, experience not only the sensory component of pain that allows them to localize the source, but also experience the sensory component as a negative perception. As mentioned above, in primary affect, the negativity is explicit because it is actually experienced by the creature. However, primary affect

is more than pain as traditionally conceived. It may help to think about primary affect by the neurophysiological mechanism that underlies it. At base, primary affect is the negative emotional experience that occurs when the limbic system, especially the amygdala, is activated. This occurs in parallel with the processing of nociceptive stimuli but also sometimes in the absence of nociceptive stimuli. When the limbic system is stimulated during the processing of a nociceptive stimulus, it is traditionally referred to as "pain." When the limbic system is stimulated in the absence of nociceptive stimuli, it is traditionally referred to as various basic emotions, most notably fear. However, emotional experiences of "sadness" when bonded creatures are removed from one another are also very common. For instance, when the children or mates of some species are removed, both parties experience something akin to sadness in humans (e.g. calf removed too early from mother cow). The full breadth of emotion for animals is unknown but any immediate emotional responses of creatures all fall under the umbrella term of primary affect.

Therefore, there are two aspects of primary affect, pain and emotional primary affect, which are bundled into the same ethical category. Neither is more considerable than the other but the two can be, more-or-less, grouped together and considered as a bundled unit. Importantly, this means that it could be just as wrong to keep an animal in an environment that is frightening to it as it is to keep an animal in an environment that is physically painful. It could also be as wrong to remove a calf from its mother too early as it is to cause the mother physical pain. This makes sense because emotional primary affect and pain (especially chronic pain and fear) have similar results on animal's well-being, perhaps because of their shared neurological pathway (Grandin and Johnson, 2006). However, to be clear, it is not the well-being per se that we are interested in for the purpose of ethics, but rather the negative subjective experience that

accompanies primary affect. Well-being is simply a means by which to evaluate the condition of a beings subjective experience.

Given that beings have an interest in avoiding the experience of primary affect, we have a responsibility to minimize the amount of primary affect we cause to creatures that can experience it. This is best expressed in the negative formulation: we have an abstract responsibility not to cause pain to reptiles, birds, or mammals because such creatures have an interest in avoiding the badness of primary affect. Similarly to creatures that feel sensory experience only, in practical cases, whether or not we should honor our abstract responsibilities depends on the circumstances and our "utilitarian calculus." However, when comparing between classes (sensory experience to primary affect) we have a significantly greater responsibility to creatures that can experience primary affect than can experience sensation only, because creatures that experience primary affect explicitly experience the badness of pain and emotional primary affect.

III.3 Secondary Affect

Secondary affect is closest to the intuitive definition of suffering. Secondary affect is characterized by an evaluation of pain on a higher level than merely sensation or initial feeling. Here, "pain" roughly means a general category of negative stimuli (pain being perhaps the most common of) that can result in suffering. In order to not be obtuse, I will continue to refer to this as pain though, strictly speaking, secondary affect is not limited to only experiences of pain. It is concerned with the big picture of how the pain affects the creature that experiences it. For example, if I break my leg, initially I will experience the nociceptive sensation so I can determine where I am injured. Because I'm a mammal, I also experience this sensation as painful

which will make me feel subjectively "bad." Then, because I'm a higher cognitive creature, I also can associate the pain with the broken leg and what it means for me. In this dimension I can suffer more or less than other comparable creatures based on my other interests. For example, a normal human suffers much less from a broken leg than a professional athlete because an athlete realizes that a broken leg has great implications for her life aside from not being able to get around as well in day-to-day life. As this example indicates, secondary affect is usually concerned with the long-term implications of pain for the creature that experiences the pain.

Secondary affect is different from the first two because not every instance of pain will trigger secondary affect. For instance, if I were to bang my knee on a table, in normal circumstances, I won't consider any implications of banging my knee on the table. Therefore, I do not experience any secondary affect from banging my knee. This general trend of not experiencing secondary affect applies to most small injuries that, intuitively, creatures do not seem to suffer from. However, the fact that secondary affect does not always operate with pain has interesting ethical implications for the relationship of secondary affect with primary affect. When we compared primary affect to sensory perception, we saw that primary affect deserved more ethical consideration. When we compare primary affect to secondary affect, it is not so clear that secondary affect deserves any more consideration. As mentioned above, secondary affect is only active in *some* of the circumstances that primary affect is. In addition, there is a worry that showing a preference for this higher-order interpretation of pain is simple anthropomorphism. In other words, we might care more about these higher interpretations just because humans experience them, which is speciesist. In a similar vein, you might just think that secondary affect is just a kind of emotional primary affect or mental form of pain, different from but no more considerable than, the experience of primary affect.

When we inspect secondary affect more closely, it becomes apparent that it is a very cognitively charged form of pain. Because it deals with future implications of pain, it requires a certain ability to form a cause and effect chain connecting the pain with some lifestyle down the road that is lesser than would be desired. Therefore, it is no wonder why only the creatures at the highest end of the cognitive spectrum might experience secondary affect. There may be some truth to the claim that secondary affect is just a mental form of pain. However, there are at least certain instances in which secondary affect requires that we give moral consideration to a case where primary affect does not. In cases where a creature perceives that its life is bad in some respect (regardless of if it actually is or not) that creature may suffer from this perception. Thus, just as secondary affect doesn't occur with every case of primary, primary doesn't occur with every case of secondary. A classic example of secondary affect without primary affect is depression. Depression can occur with little (or no) physical pain. Even when depression occurs along with physical pain, the depression itself is still distinctly different from the pain that is associated with it. However, the absence of primary affect in some cases of depression makes those cases no less morally considerable from the secondary affective standpoint.

How should secondary affect impact our practical ethical consideration? This question can be approached from two angles. First, as in the case of depression discussed above, secondary affect expands the scope of moral consideration to include creatures that have an interest in not experiencing secondary affect. However, there is also the issue of whether secondary affect deserves *more* moral consideration than primary affect. This second question is currently out of the scope of my neurophysiological theory because the capacity is not very well understood and the science of the brain regions that participate in secondary affect is still

disputed. Without knowing the biological reasons for why secondary affect would be different than primary, there is little that can be said with any certainty about our relative moral obligations. This is because the greater moral obligation should track the capacity that has a greater effect on the creature. For example, if it turns out perceptions associated with secondary affect are glaringly vivid and cause the emotional centers to be more active (much more so than primary affect), then interests in avoiding those negative perceptions should receive more moral consideration than comparable interests in avoiding perceptions of primary affect.

The additional brain organization required to experience secondary affect suggests that conscious perceptions generated by this pathway might have more "badness" than those generated by the primary affective pathway. However, this depends on the greater degree to which the limbic system might be stimulated, and this is difficult to determine. Therefore, I will weakly suggest that our intuitions that secondary affect (suffering) is worse than primary affect (pain) are more than mere anthropomorphisms and may be supported by science. Thus, it is *likely* worse to cause a creature to experience secondary affect than primary affect. However, because there is no substantial science to support this, when I consider cases I will treat primary affect and secondary affect as having the same degree of badness. Even if they are the same degree of badness, secondary affect still gives additional responsibilities as compared to primary affect only. This will become clear in the next section when I discuss the practical case of eating meat from a humane farm.

Part IV: Case Study

Earlier, we considered some cases that Singer's theory has some trouble answering. Now, I would like to attempt to answer them using my own neurophysiologically grounded theory of animal ethics. During the discussion of these cases, I will assume that the science the neurophysiological theory is based upon is correct. However, in light of new scientific information, the ultimate answer to the some of the cases may change. Therefore, this discussion of cases is intended to provide an example of how to use the neurophysiological theory to determine practical cases rather than to reach any final verdicts.

IV.1 Case 1: Factory Farming

Factory farming (as it pertains to turkeys, chickens, cows, and pigs) causes lots of harm to the animals within the system. Factory farming is so harmful to animals that any ethical theory that takes into account non-human animals should say that it is immoral to eat meat from a factory farm. This is the case with Singer's theory and our intuitions as well. Therefore, factory farming will provide an early litmus test for my neurophysiological theory. If the NP theory isn't able to definitively say we shouldn't eat factory farmed meat, it must miss out on something very important. In order to evaluate a case on the NP theory, it is important to first see where on the spectrum the relevant animals fall. In the case of eating factory farmed meat the relevant animals are humans, birds, and mammals. Then, we can look at the ethical classes each animal falls into. Humans are able to experience secondary affect while the birds and probably the mammals in

question can experience only primary affect. Therefore, we have some ethical responsibilities to humans that we might not have to factory animals. However, in this particular case, that is not particularly relevant. Factory farms cause the animals within them to experience a great degree of negative primary affect. Humans may experience negative secondary affect and emotional primary affect (discussed in greater detail in the pescatarian case) from not eating meat, but the amount of total affect will be small in comparison to the animals. Because the amount of primary affect experienced by animals in factory farming is so much greater than the amount of total affect experienced by humans abstaining from meat, eating meat from a factory farm is wrong.

IV.2 Case 2: Pescatarians and Cow-fishing

Earlier, we saw that Singer's theory seemed to have some trouble distinguishing between cases where the same interest is possessed by different creatures. This manifests itself in the fictional sport of cow-fishing (and also in the pescatarian lifestyle). Just to recap, cow-fishing is similar to regular fishing except with a (proportionately) larger hook used to catch cows. Intuitively, both cows and fish have an interest in avoiding the pain from the hook. However, recreational fishing is a popular activity and cow-fishing (or anything analogous except bull fighting[9], which is widely considered cruel) is not. This may be because we have an intuition that cows would suffer more from the practice of fishing than fish would. However, Singer might have a hard time saying that cows *do* suffer more without sounding speciesist. Of course, Singer doesn't want to endorse speciesism so his theory might decide that cows and fish would both suffer the same amount from fishing, which is contrary to intuition.

[9] Recreational hunting is another practice that is analogous to cow-fishing but actually is a fairly popular activity. This might mean that our intuition that cow-fishing is more wrong might really be cultural but, ultimately, our intuitions are not all that important to my overall point.

The NP theory first determines where cows and fish fall upon the cognitive spectrum. Cows (mammals) are higher on the spectrum than fish. From this alone, the NP theory can determine that cow-fishing is more wrong than normal fishing because cows have a greater neural organization which results in more frequent, more defined conscious perceptions. However, there is still more to be said. Fish are in the category of creatures that experience only the sensory component of pain (or properly speaking, nociception). Cows are in the category of creatures that experience pain as primary affect as well as sensation. Further, cows (as mammals) are relatively high within the class of animals that experience primary affect. Fish have an interest only in avoiding the sensation of nociception and cows have that interest in addition to the interest of avoiding the pain. Therefore, it is *significantly* more wrong to cow-fish than to regular fish because fish will experience the hook as a sensory perception and cows will experience the hook as a pain perception.

A similar conclusion can be reached for the question of whether one should be a pescatarian or a full carnivore. Because fish experience only the sensory component of pain, people who eat fish rather than other meats are greatly more ethical. However, a further question could be asked as to whether eating fish is unethical at all. This is more difficult to answer. We know that, in abstract, we have a weak (but still ethically significant) responsibility not to cause fish to experience sensory nociception. The process of catching (or farming) fish for food undoubtedly causes them sensory nociception. However, we must weigh our responsibilities to fish with our desire to eat them (which, as I discussed, is a more serious desire for most than Singer admits). Our responsibilities to fish seem greater than the trivial desire Singer thinks meat eating is. However, given that meat eating is more than a trivial desire – as I believe it is for

many people – it may vary by person whether or not it is ethical to eat fish. This may seem like an ethically unsatisfying answer but, in reality, people have different desires to eat meat. Some people have a much stronger desire than others. For some people, abstaining from eating meat may cause them to experience secondary affective suffering catalyzed by cultural or other factors. These factors, even if only cultural, *do* give people a legitimate interest in eating meat. However, this interest must still be weighed against competing interests. The experience of secondary affect is more morally considerable than the sensation of nociception experienced by fish. Therefore, if a person does experience secondary affect from abstaining from eating meat, they would suffer more than the fish if it were being eaten. In this case, it would be ethical for that person to eat meat.

However, I believe that many people have a weaker desire to eat meat and experience little to no secondary affect from abstaining so, for them, it may be unethical to eat fish. Ultimately, it should be remembered that it is wrong (in abstract) to cause a fish to experience nociceptive perceptions because fish implicitly have an interest in avoiding them, as demonstrated by avoidance behavior. Therefore, each person should evaluate their subjective interest in eating fish against the fish's interest to avoid sensory nociception and determine which is more important. If an honest (and serious) consideration of a fish's interests as described here yields no motivation to abstain from eating fish, then eating fish may be ethical for that person.

This conclusion, understandably, may leave some readers with an uneasy feeling that my system of morality is subjective or prone to abuse by some kinds of people. However, this is not the case. The final thought that each person should evaluate the wrongness of eating fish for themselves is simply a useful litmus test rather than a subjective moral stance. It is an objective

fact whether or not eating fish is morally permissible for a particular person. Reflecting on the mental capacities of fish is just a way to get at this ethical fact. Now, the question may be, 'if morality is objective, why wouldn't it be the same for all people given the similarity of their capacities?' The answer to this is simple: people are not all the same and neither is their interest in eating fish! Most people have a relatively trivial interest in eating fish because they do it for taste alone. In these kinds of cases, the fish's interest seems to trump the human's interest. For these people, this conclusion may come from an honest and serious reflection as described above. Other people have a more serious interest in eating fish (eg. dietary requirements, deeply engrained cultural traditions, survival, etc.) and for these people eating fish is likely morally permissible.

Now that I have argued for giving moral consideration to fish, while not forgetting the reasons we should consider them, it is important to note that eating fish is *much* better (ethically) than eating other animals such as cows, pigs, or chickens. This is because fish cannot feel the badness of pain while those other creatures can. Therefore, adopting a pescatarian diet is a much larger step towards ethical eating habits than moving from a pescatarian diet to a vegetarian or vegan diet. This is not to say simply stop at pescatarianism because eating no meat at all is still better for most people, but eating fish only is a much better moral position than eating all meats. In a similar vein, eating chicken rather than cow or pig is ethically better (assuming they were all raised under similar conditions). This is because though chickens can feel pain, they cannot do so with the full breadth that cows and pigs can. However, shifting from a full carnivore diet to chicken is not nearly as good as abstaining from all meat or eating fish only (because chickens *can* still feel pain). Distinguishing between these steps of abstinence is useful because eating some kinds of meat is better than eating others and each step helps. For people that

wouldn't/couldn't cut out all forms of meat from their diet, simply adopting the diet at the next step of abstinence is ethically beneficial. Of course, not to get caught up in abstract talk about ethics, practically, adopting the diet at the next step of abstinence is physically beneficial to all the animals that would have been eaten[10].

Steps towards Abstinence (<< denotes much better)

Vegan < Vegetarian* < Pescatarian* << Poultry Only < Full carnivore

IV.3 Case 3: Lacto-ovo Vegetarians? Ovo-Pescatarians?

In the above "Steps towards Abstinence," I provided a version of the traditional abstinence scale only slightly updated by my neurophysiological theory. However, you will notice that I flagged both pescatarian and vegetarian. This is because the vegetarian and pescatarian categories can have several modifiers attached to them that indicate the inclusion of various food groups that actually make their positions less morally defensible than they appear at first glance. The 'lacto' prefix means the diet includes dairy products and the 'ovo' prefix means the diet includes eggs. Therefore, a lacto-ovo-vegetarian eats no meat but does eat dairy products and eggs. Similarly, an ovo-pescatarian eats no meat except fish and also eats eggs, but abstains from dairy. Traditionally, vegetarian means lacto-ovo-vegetarian while a person that is a vegetarian but does not eat eggs or dairy is termed vegan (though typically vegans omit all animal-based products from their diets including honey and some kinds of sugar). However, if

[10] Of course, here some would argue that the meat industry will process the same number of animals regardless of whether or not a single person abstains. This is, doubtless, true however, such an attitude may prevent many people from abstaining from meat. If many people abstained (as many now do), the meat industry would almost certainly process fewer animals, which produces a tangible benefit to some animals. However, even if the meat industry did not scale back production, eating meat from factory farms is still participating in a flawed system that fails to consider the interests of many animals, which is wrong for all participants. Still, the primary concern is the interests of the animals, whether they be considered at the level of the system or the individual animals.

we consider vegetarian to really mean lacto-ovo-vegetarian, then vegetarians may not always be acting more ethically than pescatarians, specifically ovo-pescatarians.

This, I imagine, is a claim that turns traditional thought about ethical food categories on its head but should make sense if you endorse my neurophysiological theory. Traditional vegetarians eat eggs and dairy products but no fish, while ovo-pescatarians eat fish and eggs but no dairy. So, the real difference between the two is whether or not eating fish is worse than eating dairy or vice-versa. In other words, is it worse to raise and kill fish or to raise and milk cows? First, let's consider fish. Fish can experience the sensation of nociception which means that they will experience no pain from being raised in artificial settings or being caught from the wild, though they will experience some degree of nociception. Then, the fish will be killed. However, death is not a harm for fish because, as I will argue in the next case below, secondary affect is required for death to be considered a morally relevant harm.

Dairy cows, on the other hand, are typically force-impregnated (to induce lactation) and then have their calves removed from them at a young age in order to claim as much of the mother's milk for humans as possible. Removal of the calf is a fairly traumatic event in the mother cow's life and causes a lot of emotional primary affect. In some of the worst dairy farms, the dairy cows are also confined to very small stalls and otherwise poorly treated as well, but for the purpose of this case, let us assume the cow has a pleasant life aside from being forced to lactate and having her calf removed (which is a necessary process to get cheap milk in large quantities). Even assuming a decent dairy cow treatment, dairy cows are worse off being milked than fish are being raised and killed. Therefore, *it is usually more ethical to eat fish than dairy products.* However, the exception to this might be cows that don't have their calves removed

until the calf is ready to naturally leave the mother. It is still possible to obtain milk in this way (the calf cannot drink it all), but the quantity is much less. Of course, there also remains the question of what happens to the calf, for it is certainly worse if the calf is later slaughtered (as usually happens, especially to male calves), though these in-depth considerations of this particular case are out of the scope of this paper.

Eggs don't require the same detailed discussion that dairy products do. Assuming that the birds who are laying the eggs are free-range and fed a diet that is appropriate for them (and so on), most birds – and certainly the ones typically used for the egg industry – don't seem to mind at all when their eggs are collected and they will produce them anyway. Therefore, there is nothing ethically wrong with eating eggs from properly cared for birds. Of course, if the birds are not free-range there are ethical concerns dealing with the welfare of the birds but, realistically, free-range eggs are easily found and affordable so I do not believe that it is necessary to offer lengthy arguments in favor of free-range eggs over factory farmed eggs as it is almost no extra effort to buy free-range for many people.

In the aftermath of this discussion, redefining the above "steps towards abstinence" is required. Namely, ovo-pescatarian is more ethical than lacto-ovo-vegetarian (though not quite as good as ovo-vegetarian).

Revised Steps towards Abstinence (L=lacto, O=ovo)

Vegan < O-Veg. < O-Pesc. < L-O-Veg. < L-O-Pesc. << Poultry Only < Full Carnivore

IV.4 Case 4: "Cruelty-Free" Meat

There is an increasing number of farms that aim to raise animals humanely and slaughter them with minimal pain in order to provide a "cruelty-free" meat product. This is beginning to be done as more and more people realize what occurs on most factory farms. Some people who think eating meat from factory farms is wrong also think that eating meat from a humane farm would be acceptable. Singer acknowledges that humane farms are much better than factory farms but it is still clear that Singer thinks eating meat from them is wrong. However, as discussed before, Singer doesn't have a strong argument for why exactly eating meat from humane farms might be wrong. When we apply my neurophysiological theory, we see that this case is very similar to factory farming in that the factors that need to be considered and weighed against each other are the human experience of emotional primary affect and secondary affect on one hand, and the animal experience of primary affect on the other. In factory farming, the animal primary affect so far overshadowed the secondary affect suffered by humans that no fine distinctions were needed: factory farming was clearly wrong. However, in humane farming, animals experience much less primary affect (you might think there is only the pain of slaughter), while humans still experience the same amounts of primary and secondary affect. Now, it seems like the two amounts of affect are more comparable.

If we stipulate that in a humane farm an animal lives a happy life until the moment of slaughter, there seems to be very little primary affect (if any at all) experienced by the animal. If slaughter is done in the most humane way, an animal (or human) would never anticipate it. You might imagine that a worker gives the animals a shot that euthanizes all the animals in the course of normal interaction so the animals never suspect a thing. Only after all animals are euthanized are they moved to a slaughterhouse to be drained of blood and prepared as meat. Alternatively, you might imagine the shot is heavy sedation such that the animal wouldn't wake up before it

was killed in the slaughterhouse. Therefore, there would be no fear to contribute to emotional primary affect. In addition, either because the animal was chemically euthanized or because the animal was heavily sedated, the animal might experience only the pain of the needle. Presumably in animals (as well as in humans) an injection causes very little primary affect. (Interestingly enough, the phobia that some people have of needles which far exceeds the pain of the needle in terms of degree, seems to be a function of secondary affect.) In this case, the primary affect from the needle is much less than the total affect experienced by a human abstaining from meat. Of course, the farm I have envisioned here is very strict and the animals on it experience almost no pain. This probably isn't practical but there is a bit of leeway in terms of the amount of primary affect animals on the farm could experience before the primary affect would exceed human total affect. Therefore, if this is the only relevant consideration, eating meat from a sufficiently humane farm is ethically acceptable.

However, as you might imagine, there is more to the story as I will illustrate with an example. In the previous example, we imagined an animal on a farm that has lived a roughly pain-free life until the needle prick that will ultimately lead to its death. Now, let's imagine a dictator with unusual cravings for human meat pays a doctor to inject a human with a similar solution that the animal was injected with. Furthermore, to avoid suspicion, the dictator has the doctor inject it in a patient that was coming in for a shot anyway so the human patient is not fearful in the slightest when the doctor pulls out a needle. Of course, we know that the human will be injected with this concoction that will either outright kill him or sedate him so that he can be butchered later. Then, this human will be served to the dictator. On the neurophysiological theory, as conceived so far, the dictator has done nothing wrong. Much like the animals on the farm, the human experienced so little primary affect that the dictator would have experienced

much more total affect had his craving not been filled. However, we have a strong intuition that eating a human, even in this fashion, is still wrong.

In actuality, my neurophysiological theory agrees with our intuition. So far, we have only considered the primary affective dimension as it related to killing. In at least humans (and, doubtless, others), there is also a secondary affective dimension. A being that can experience secondary affect also has a condition of life that it expects, complete with goals and future interests. This is a prerequisite for secondary affect because the badness of secondary affect involves the frustration of these goals and interests. For example, when the athlete breaks her leg, she realizes she may have a future in which some of her major goals will go unfulfilled (winning the championship). She will likely consider this much worse than the pain of breaking her leg. Implicit within all the interests of a being that can experience secondary affect is a foundational interest to be alive because it is only through being alive that one can fulfill other interests. Therefore, death is a very bad thing for a secondary affective being because it results in the frustration of all interests[11].

It may be argued that death isn't bad because death doesn't frustrate all desires, it just causes the being not to have them anymore (a fairly subtle difference). Further, it may my argued that the being doesn't *experience* the frustration of the desires because the being is dead and so is void of all experience. These objections are somewhat related but neither is a true objection. I will reply by example. When punishing a child, there are at least two common methods, negative and positive: either take something the child values (toys, etc.), or add something the child dislikes (a spanking, extra chores, time-out, etc.). Both achieve the same goal – to cause

[11] In circumstances where the being has no further desires or goals or the present experience of affect is worse than the frustration of all future goals (as in late-stage terminal illness) based on my NP theory, it is ethical to euthanize a secondary-affective being.

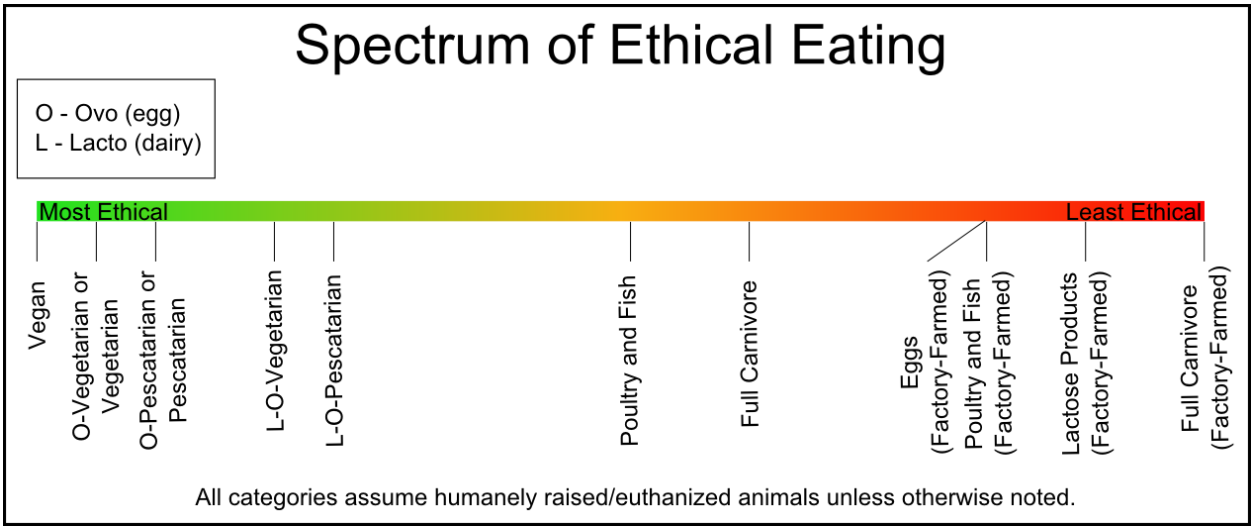
something aversive to happen to the child in order to get him to modify his behavior at pain of experiencing future iterations of the aversive stimulus. Similarly, there are two ways of causing something (morally) aversive to happen to a secondary affective being. You can either directly add negative secondary affective experience (athlete breaking a leg) or you can take away positive secondary affective experiences (goals, plans, etc.). Thus, in order to suffer, it makes no difference whether the goals are frustrated or simply vanish, either way, positive secondary affective experiences are taken away. Furthermore, the being doesn't need to experience the vanishing of the goals after death because the being experienced them positively during life. Thus, if a being has positive goals during life and nothing after death, that being has gone from a positive state to zero, which is a morally considerable change.

Not only is death bad for secondary affective individuals, it compounds the badness experienced in the primary affective dimension as well. A secondary affective being's goals and future projects contribute in no small way to almost everything in that being's life. For example, many people do things they do not want to in the pursuit of goals. Someone trying to lose weight may abstain from food they once enjoyed; someone trying to get a promotion may spend more time working than doing enjoyable things; someone trying to support a family may work multiple dead-end jobs. The point is that goals are so important to the being that expresses them that the being is often willing to be uncomfortable in the pursuit of goals. In other words, the being places a huge secondary affective focus on goals. To take these goals away (through death) is to do that being a great harm. Therefore, the secondary affective harm from having all goals lost is much greater than any harms that a person might experience from not eating meat.

However, do animals on our humane farm experience secondary affect? They might but that isn't supported by neurophysiology (at least currently). Because the science is in its infancy and the capacities required for secondary affect are so poorly understood, it is hard to tell which creatures can experience secondary affect. As we get a better idea of exactly what secondary affect is and which brain regions are responsible, we can make a better decision in this case. It is immoral to eat animals that experience secondary affect, even if raised humanely. If, as current neuroscience tends to suggest, no farm animals experience secondary affect, humane farming provides meat that is ethically acceptable. However, there is countless behavioral and anecdotal evidence to suggest that many creatures (most mammals including cetaceans, corvids, cephalopods, etc.) might experience secondary affect as discussed briefly during the catalog of animal capacities in section *II.6*. Notably, missing from that list are galiform birds such as chickens and turkeys which are the mental inferiors to corvids such as magpies.

For now, it may be best to approach eating meat from humane farms with caution but still with the understanding that eating humanely raised animals is significantly better than eating factory farmed animals because humanely raised animals experience so much less primary affect. In other words, meat eaters are participating in a much more ethical system when they eat meat from humane farms than factory farms. Therefore, there is a large degree of ethical motivation for meat eaters to eat only from humane farms, especially if they have the monetary means to do so. The figure below is the final "Steps towards Abstinence" represented as a spectrum of ethical eating. This figure assumes that farm animals experience little or no secondary affect. If it turns out farm animals do experience secondary affect, the 'poultry and fish' and the 'full carnivore' categories would be moved closer to the factory farming end of the spectrum. Of course, even if the science we know now (that I have based this figure upon) is

correct, the spacing between categories is meant to be only an approximation to provide a visual representation of an otherwise wordy categorization, rather than a definitive guide for ethical action. In other words, this figure is meant to support an understanding of my neurophysiological theory but the theory, in its entirety, is still the more accurate guide for ethical action.



Part V: Concluding Remarks

Over the course of this essay, I have had a single primary goal: to update our ethical discussion as it pertains to eating meat. Singer laid the foundation for the discussion in *Animal Liberation,* but it is now time to ground the discussion of animal capacities in contemporary neuroscience. Failure to ground animal capacities in an empirical science renders any theory of animal ethics mere speculation. However, adopting a new standard in the background of animal ethics will require a major conceptual overhaul, at least as compared to traditional thought. I have attempted to take the first step here by defining a new spectrum of ethical eating based on animal capacities, though there is still much work to be done.

In the mode of looking towards a scientific future of animal ethics, rather than summarize what I've done here, I would like to conclude by bringing up a new case, one that may forever change the ethical discussion of meat eating. What if scientists could engineer farm animals that felt no pain? Adam Shriver presents this case and argues that if we could engineer farm animals that felt no pain that we would have an ethical obligation to do so (2009). Though this may sound like they typical "philosopher's case" it actually may not be so farfetched. In mammals, the anterior cingulate cortex is responsible for much of what I have termed the primary affective dimension of pain (and perhaps also plays a role in the secondary affective dimension). Removing the anterior cingulate cortex from rats results in the loss of the unpleasantness of pain that characterizes the primary affective dimension of pain (Shriver, 2006). Therefore, it may be possible to engineer pigs and cows that experience only sensation as nociception. Indeed, Singer briefly considers the case of genetically modified organisms in *Animal Liberation.* He quickly dismisses the issue with a claim that genetic modification is using an animal as a means, which is

ethically unacceptable (1995, p. 156). However, it isn't clear how using an animal as a means is wrong on a utilitarian framework such as Singer endorses so the dismissal isn't very satisfying. Of course, it may be possible to block nociceptors as well but that would likely prove fatal for the animals because they would no longer realize when they were being harmed (for example, standing in a fire). This procedure may be applicable to poultry as well as mammals such as pigs and cows though the intricacies would need to be different to account for differences in neural architecture. Now that I have presented this – perhaps soon to be possible – case, I will conclude with some final question to consider. If we had the ability to modify farm animals such that they only experience primary affect (or perhaps no nociception at all), ethically should we do so? Further, if we assume that we can remove all traces of nociception, is there a difference between eating the resultant creature and a non-sentient one such as *Paramecium* or a plant?

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